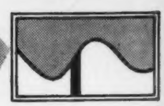
MACHINERY

DECEMBER 13 1961 ONE SHILLING & THREEPENCE

The quick and simple modern way of grinding form tools, gauges, etc., with high accuracy

The PeTeWe Projection Form Grinding Machine is the answer to many of the problems of production associated with the grinding of complicated shapes and forms to high degrees of accuracy and in materials such as tungsten carbide. The drawing, the workpiece and the grinding wheel are all clearly visible on the same large size screen and control of the grinding operations is extremely simple. The PFS 3d machine illustrated grinds work up to 2in. thick or 4in. diameter.

the drawing
the workpiece
the wheel



are all on the same screen on the

PeTeWe

Projection Form Grinding Machine

Sales and Service for the British Isles

DRUMMOND-ASQUITH LIMITED

Member of the Asquith Machine Tool Corporation

KING EDWARD HOUSE, NEW ST., BIRMINGHAM *Phone: Midland 3431.* *Also at* LONDON *Phone: Trafalgar 7224* & GLASGOW *Phone: Central 0922*

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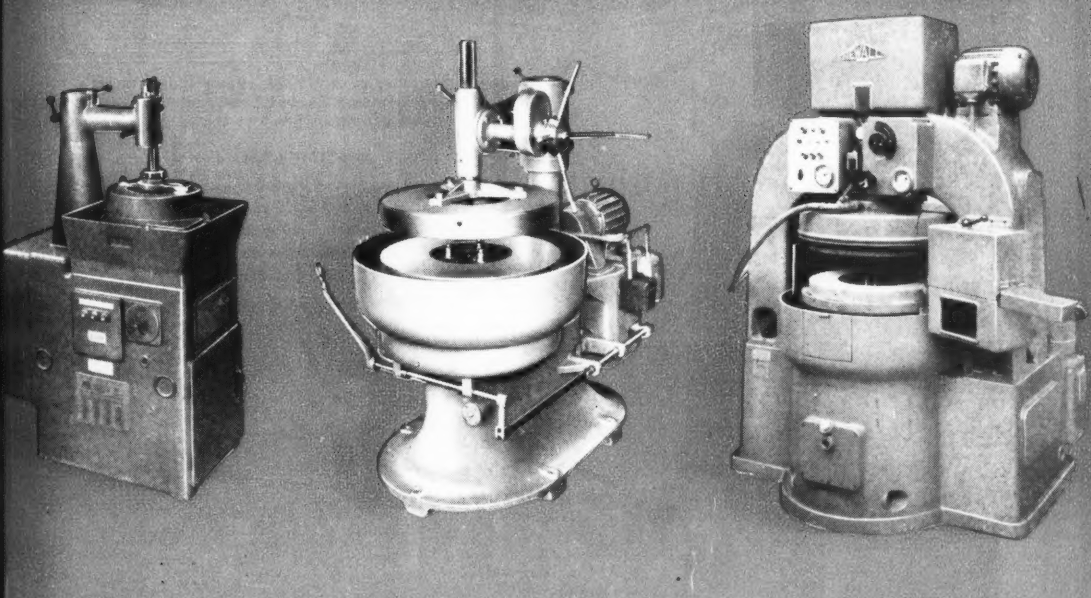
NEWALL LAPPING MACHINES

give precision, flatness & parallelism at high production rates

MODEL 10 U
Simple to operate yet producing components to close accuracy combined with high class finish, this machine has a capacity for flat work up to 3" square x 1½" thick and cylindrical work 3" long x 1½" diameter.

MODEL 2 F
Also a universal machine, model 2 F has a capacity of 8" square x 3" thick for flat work and 8" long x 3" diameter for cylindrical components.

RIGIDLAP
Latest model in the range the Rigidlap, an exceptionally sturdy machine, has contra-rotating lapping wheels and an extremely high output potential.
Maximum capacity for flat work 7" square x 2½" thick and for cylindrical work 7" long x 2½" diameter.
This machine is also offered with automatic work feed mechanism.



Our lapping division will be pleased to advise you on production problems and will design workholders to suit your components.

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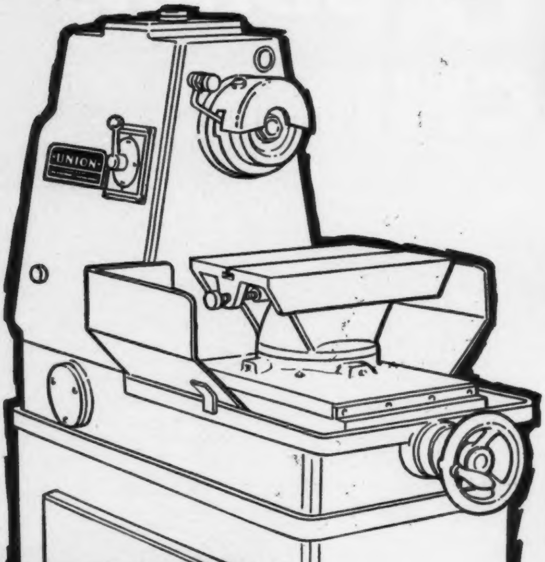

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LAPPING AND CHIPBREAKER GRINDING MACHINE

Lapping carbide tools after grinding improves performance, prolongs re-grinding intervals and gives a superior finish to the turned part.

BRIEF SPECIFICATION:

4,800 r.p.m. spindle on opposed Timken bearings.
Lapping speed 5,000 surface f.p.m.
In-built coolant pump and tank.
Fully adjustable table on ball bearing slideways.
Supplied as bench or cabinet model

above left
Table can be inclined either way up to 20°. Tool guide moves 90° with accurately graduated base.

left
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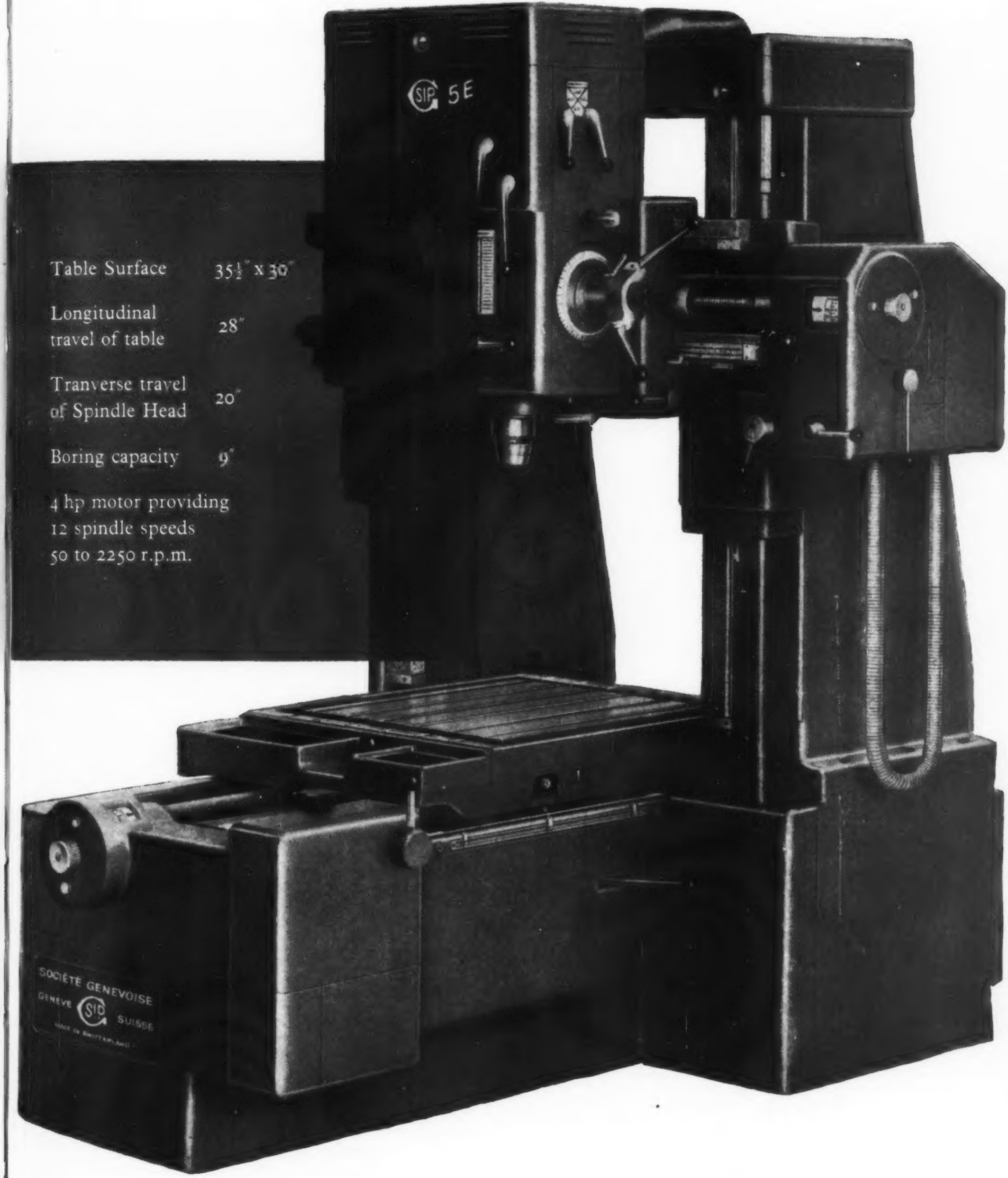

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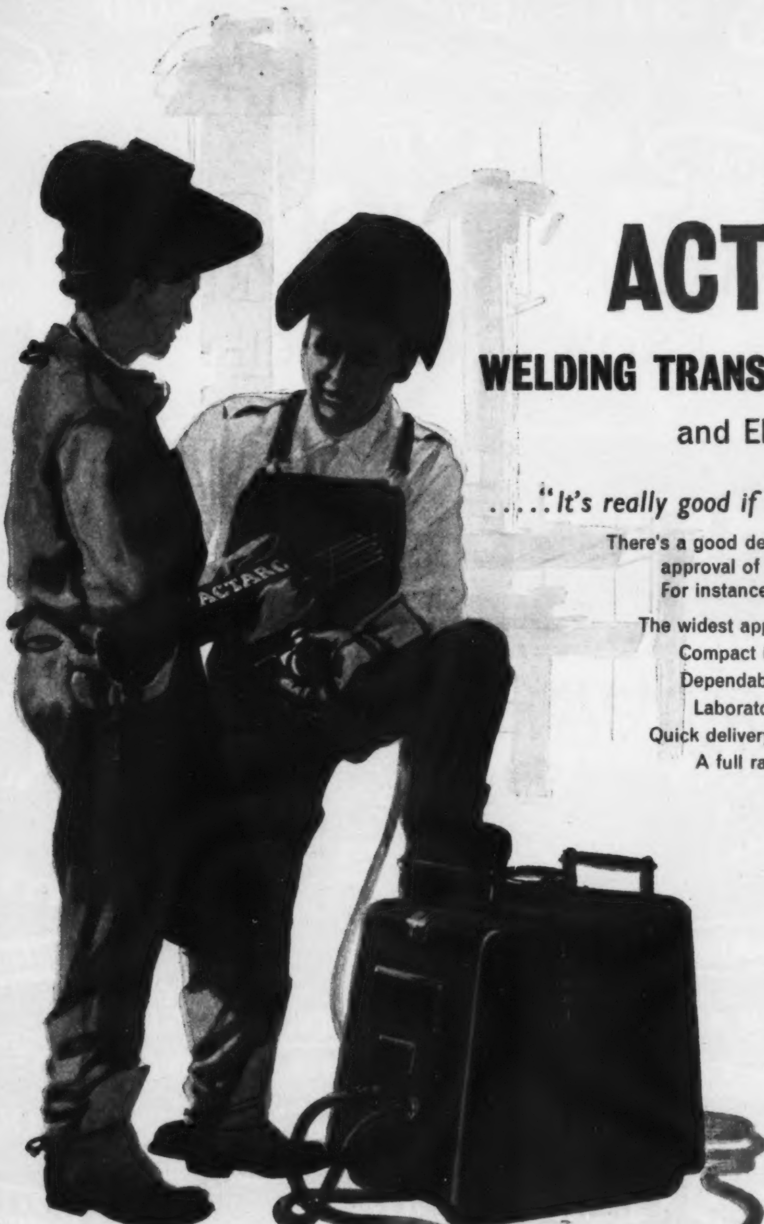
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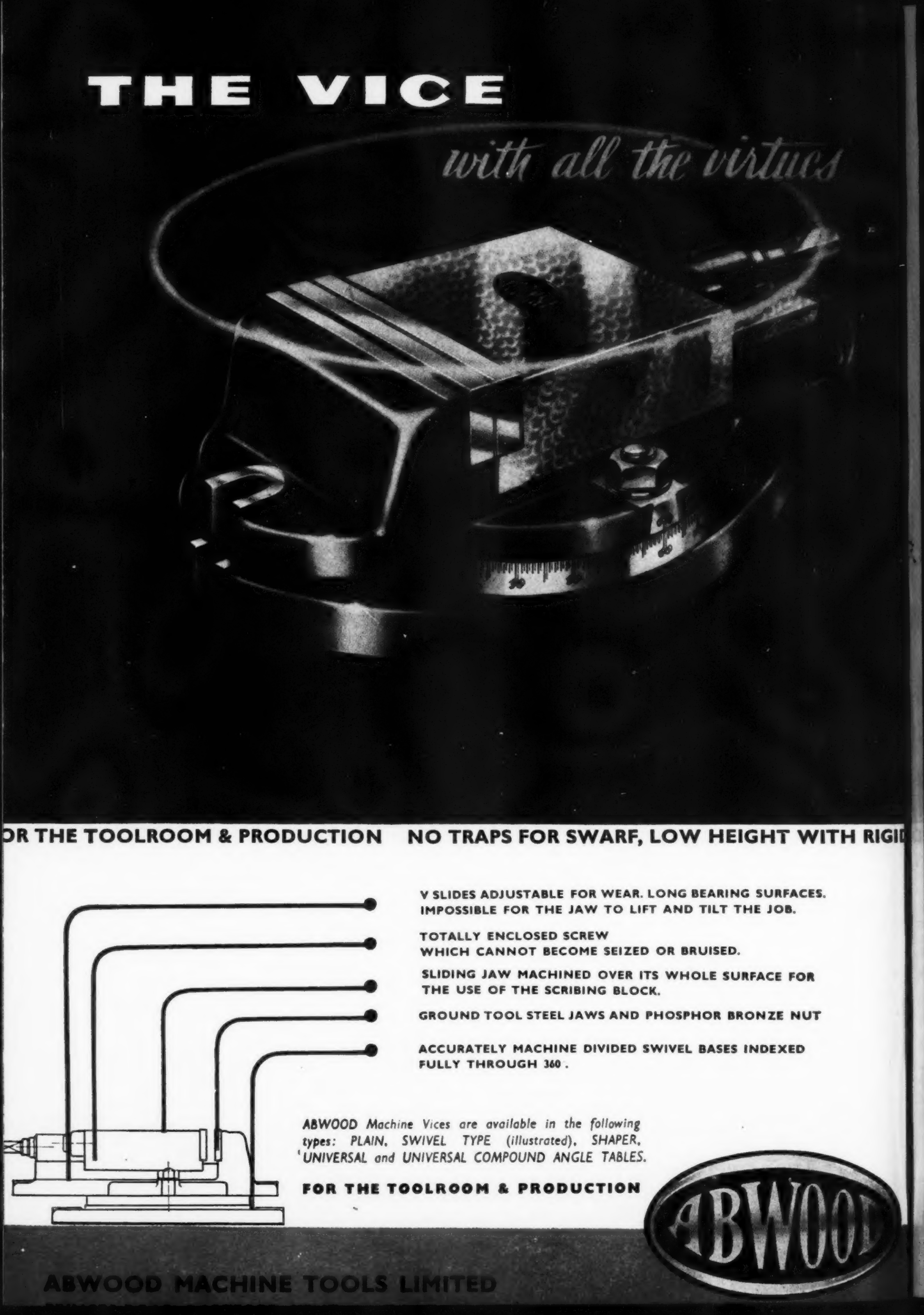
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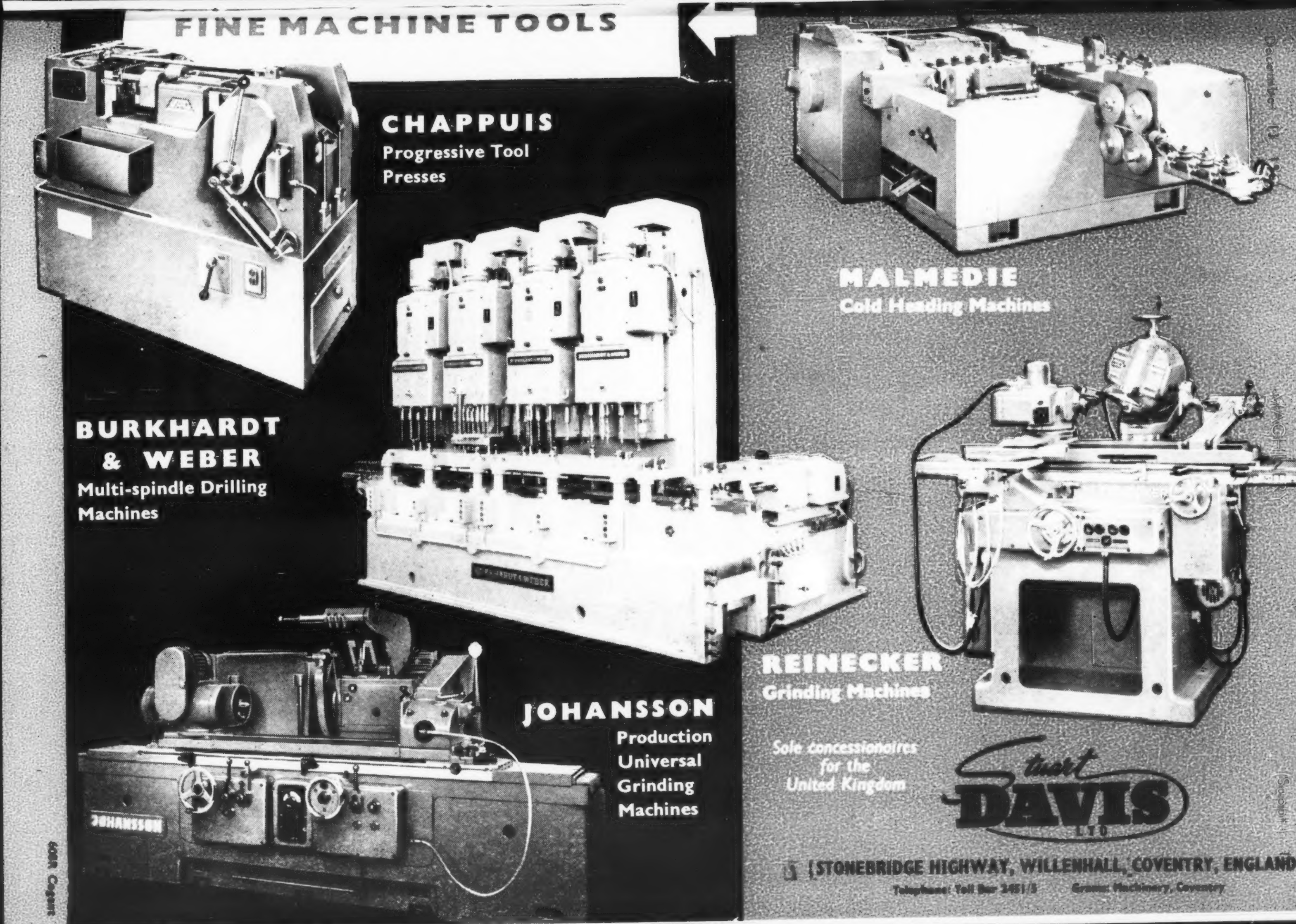
FINE MACHINE TOOLS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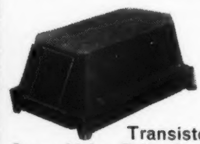
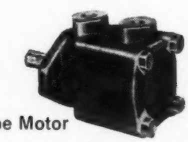
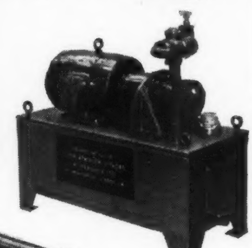
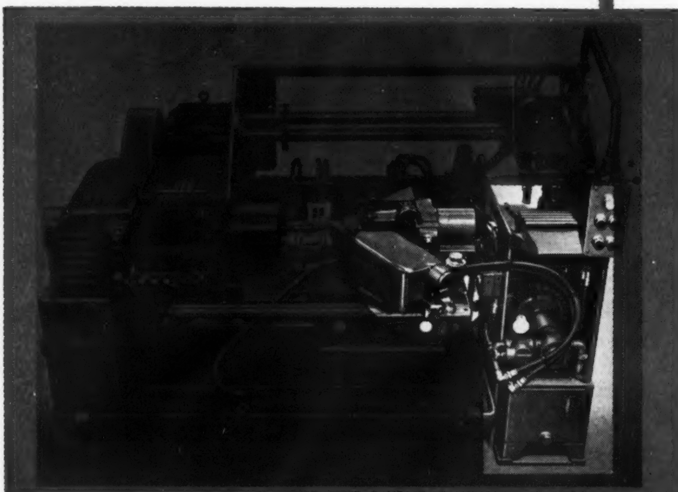

Transistorised Servo Valve Drive Amplifier


Vane-type Motor


Actuating Cylinder


Hydraulic Power Unit



Photograph by courtesy of Messrs. Drummond Bros. Ltd.

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An Electro-Hydraulic copying attachment, embodying a VICKERS power unit and other components, as fitted to the Drummond 'Maximinor' combined multi-tool and copy turning lathe.

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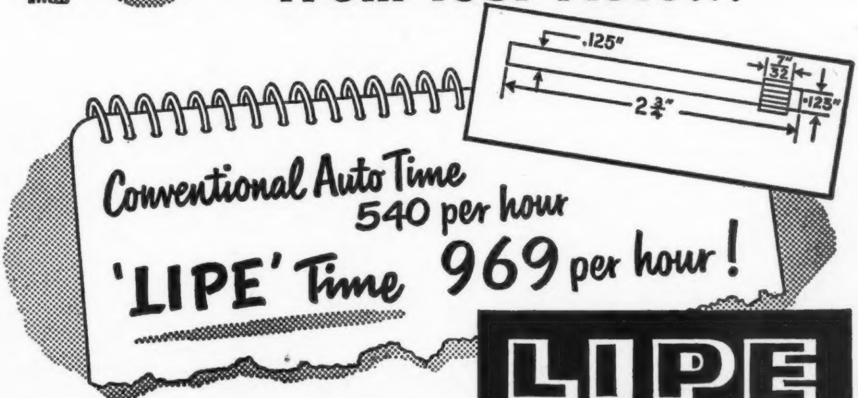

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LET US ESTIMATE SAVINGS ON YOUR EXISTING RUN

- Only 4 seconds reloading
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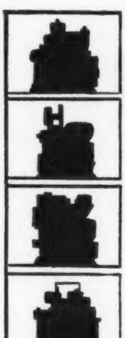
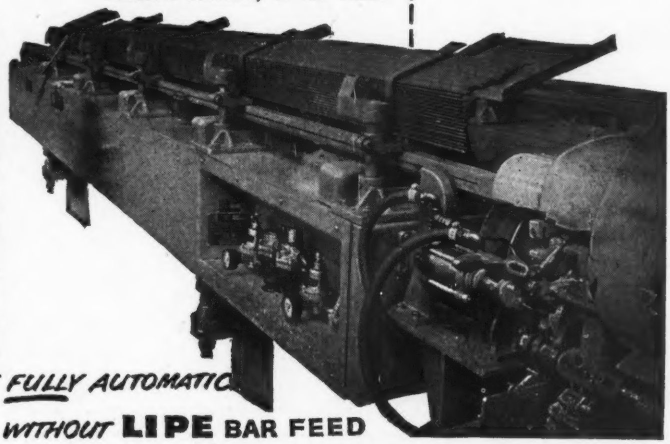
AUTOMATIC BAR FEED

THERE'S A LIPE FOR MOST BAR FED MACHINES





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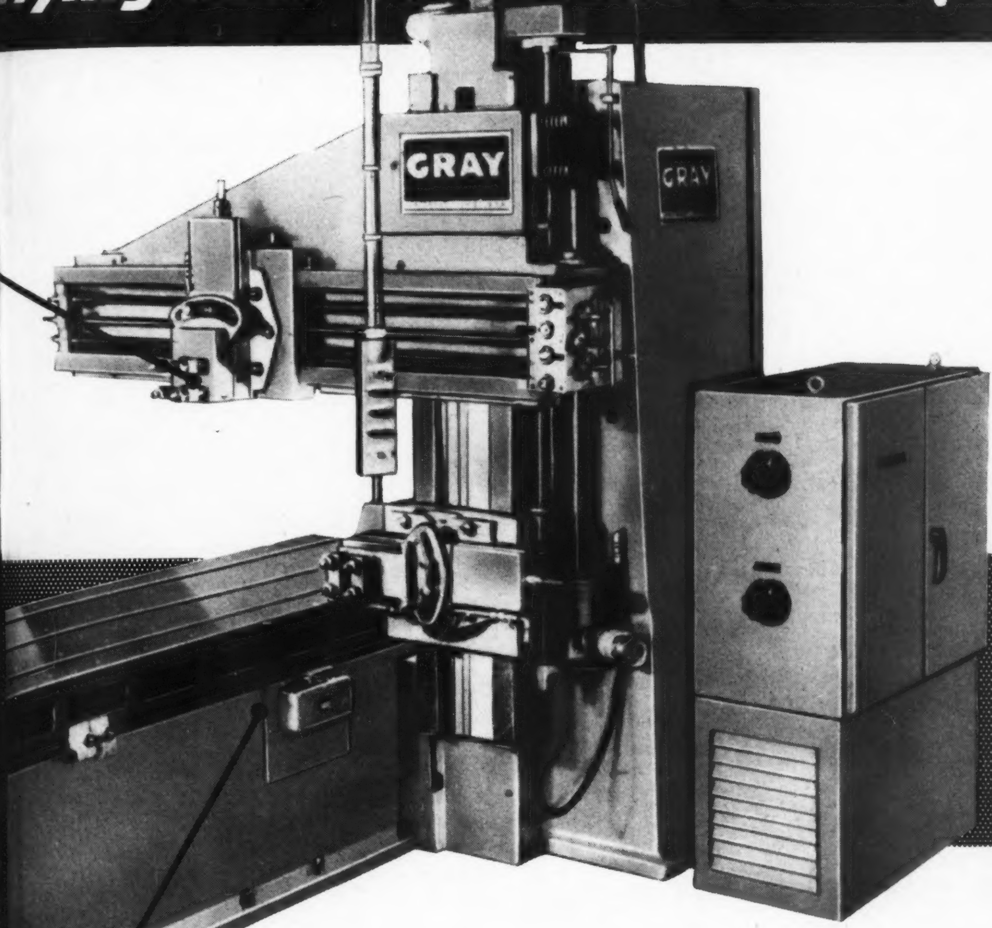

The construction of the FLYING SCOT is such that it will perform precisely for years. Carbide planing up to 300 ft. per minute makes it the world's highest production small planer.

Optional equipment includes left hand rail head and side head in either plain or universal styles.

Write now for descriptive literature.

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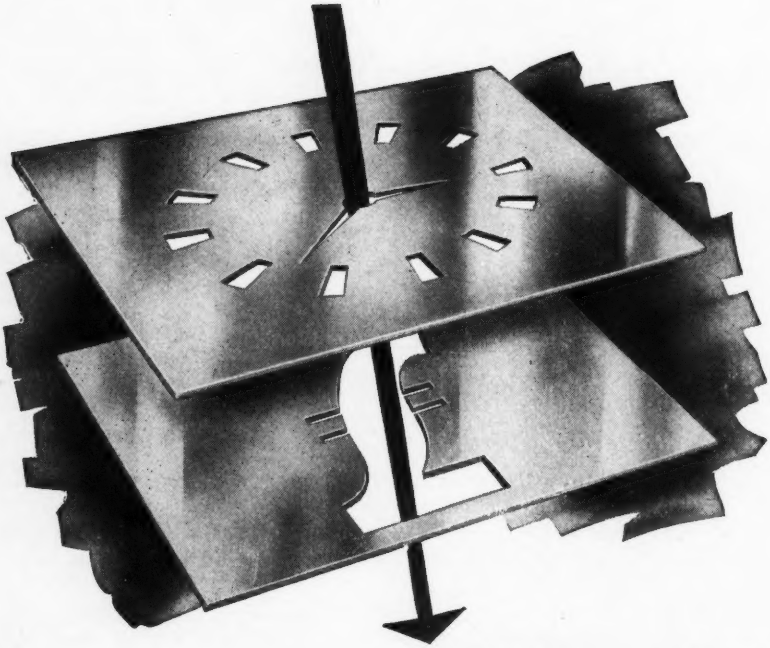

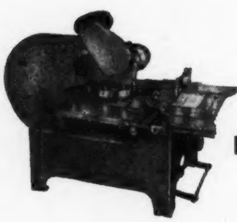

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Making the NEW

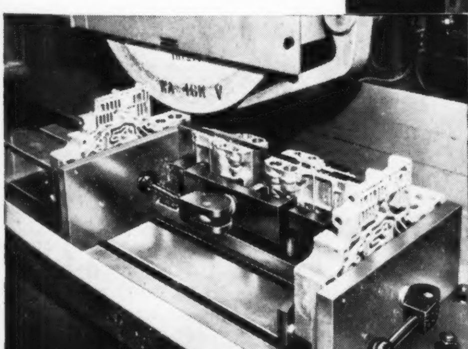
B-W Automatic 35 TRANSMISSION

MATRIX QUALITY

BRITISH-BUILT

THOMPSON Surface Grinder

One of the many British-built Thompson Surface Grinders installed by leading manufacturers, this 16″ x 12″ x 40″ Machine is grinding to close tolerances valve bodies for Borg-Warner Automatic Transmissions.



Built by Coventry Gauge and Tool Co. Ltd., Thompson Surface Grinders for plain or form grinding are available with table sizes from 8″ x 24″ to 36″ x 240″.

ROCKWELL MACHINE TOOL CO. LTD.

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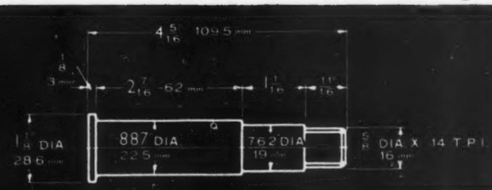

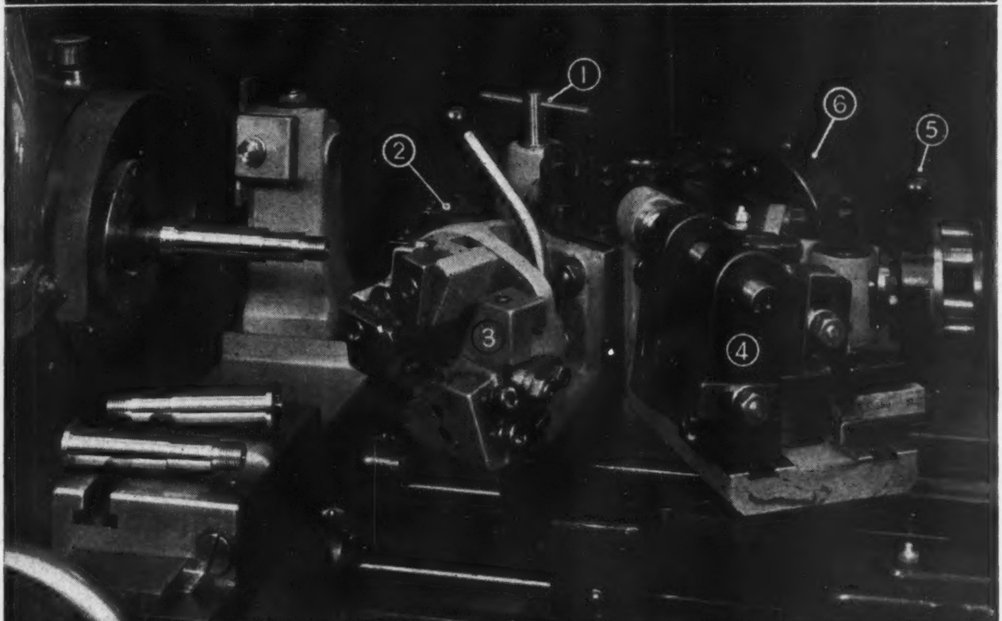

STEEL SPINDLE

1 1/16" dia. Steel Bar E.N.8.
40 ton Tensile Steel
Tungsten Carbide Cutting Tools.

2DS CAPSTAN LATHE

Code Word : **Twods**

Fitted with 1¼" Air Bar Chuck and Air Bar Feed.

Floor to Floor Time :
1 min. 45 secs.

DESCRIPTION OF OPERATION	Tool Position		Spindle Speed R.P.M.	Max. Cutting Speed		Feed	
	Hex. Turret	Cross-slide		Feet per min.	Metres per min.	Cuts per inch	m/m. per rev.
1. Feed bar to stop & close chuck	1	—	—	—	—	—	—
2. Centre drill	1	—	1110	—	—	Hand	Hand
3. Start turn	2	—	1110	343	104	Hand	Hand
4. Tangential roller turn ·887" dia.	3	—	1110	343	104	130	·195
5. Multiple roller turn 1⅛", ·762" & ·579" dias.	4	—	1110	343	104	130	·195
6. Thread roll ⅝"×14 t.p.i.	5	—	1110	181	55	—	—
7. Roller end and chamfer	6	—	1110	181	55	Hand	Hand
8. Tangential part off	—	Rear	1110	327	100	Hand	Hand

'PRELECTOR' Combination Turret Lathes with Preselective speed-changing.

TURRET LATHES with capacities up to 35 in. swing over bed

1¼ in. to 2¼ in. 'D-S' DOUBLE-SLIDE Capstan Lathes for heavier accurate work.

Stock Tools, Toolholders, Chucks and Accessories for Capstan and Turret Lathes.

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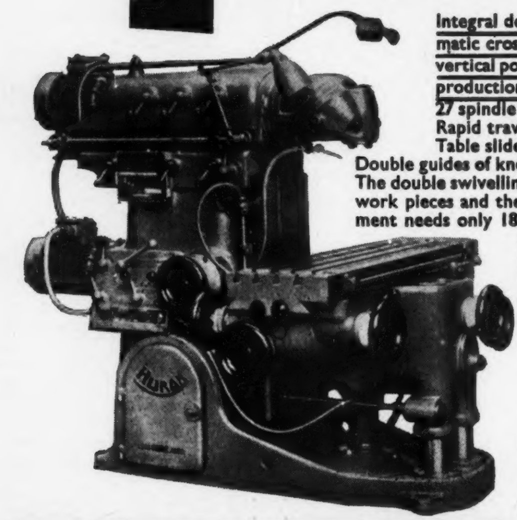
W684

SLIDING RAM GIVES 27½in. AUTO CROSS FEED

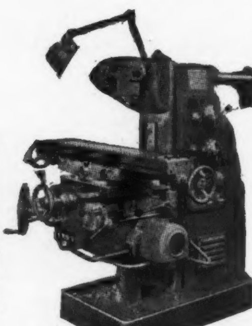


Integral double swivelling universal head provided with 27½in automatic cross feed by the sliding ram, can be set to the horizontal or vertical position, or to any angle instantaneously—permits the heaviest production cuts. Heads can be retracted completely from table line. 27 spindle speeds from 30 to 2,066 r.p.m., 27 feeds from $\frac{1}{16}$in. to 30in. Rapid traverses in all directions. All operating controls duplicated. Table slides directly in the knee without cross movement or swivel. Double guides of knee permit components in excess of 1½ tons to be machined. The double swivelling universal head requires an opening of only 14in. to enter work pieces and the whole sliding ram with its 27½in. automatic cross movement needs only 18in. clearance. OPTIONAL EXTRA FEATURES: Mounted spacing casting assemblies providing additional 8in. capacity under spindle. 26in. wide 8 T-slot tables and 39[illegible]in. automatic cross feed of sliding ram with special heavy duty knee and front operating position.

Type	Table	Automatic Feeds Long	Cross	Vert.
KU4	56[illegible]in. × 15[illegible]in.	43[illegible]in.	27[illegible]in.	19[illegible]in.
KU5	64[illegible]in. × 15[illegible]in.	51[illegible]in.	27[illegible]in.	19[illegible]in.
KU6	78[illegible]in. × 16[illegible]in.	59in.	27[illegible]in.	19[illegible]in.
KU55	64[illegible]in. × 26in.	51[illegible]in.	38[illegible]in.	18[illegible]in.
L83	157in. × 59in.	118in.	39[illegible]in.	59in.

HURON MU.6/FERRANTI 3-D MILLER

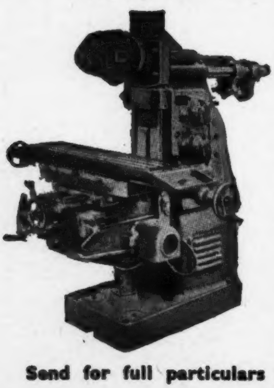
Type 'L' Open-side Traversing Head Universal Miller will mill, bore, slot and drill the largest work-pieces at one setting. The unique design permits greatest variety of operation on large work-pieces; the component remains stationary on the large work-table. Upright slides full length of base table and the sliding ram moves vertically and horizontally.



DUFOUR UNIVERSAL MILLERS

WITH DOUBLE UNIVERSAL SWIVELLING HEAD, RETRACTABLE SLIDE BRACKET AND SPACING CASTING GIVING 26" DAYLIGHT ON No.59 AND 21" ON No.61

FOR ALL MODELS Direct reading dial change for speeds and feeds. All parts subject to wear hardened and ground and completely interchangeable. Built to closest tolerances. Rapid traverses in all directions. Table swivels 30°. No. 40 taper for main horizontal spindle, double swivelling universal head, dividing head and rotary table. Hardened and ground centre guide for slideways. Twin overarms. Double swivelling sliding spindle heads with speeds 53-3000 r.p.m. Double swivelling universal head on retractable slide bracket providing with 5½in. Spacing Casting Drive assembly on 59 Machine 26in. daylight, and 21in. on No. 61.



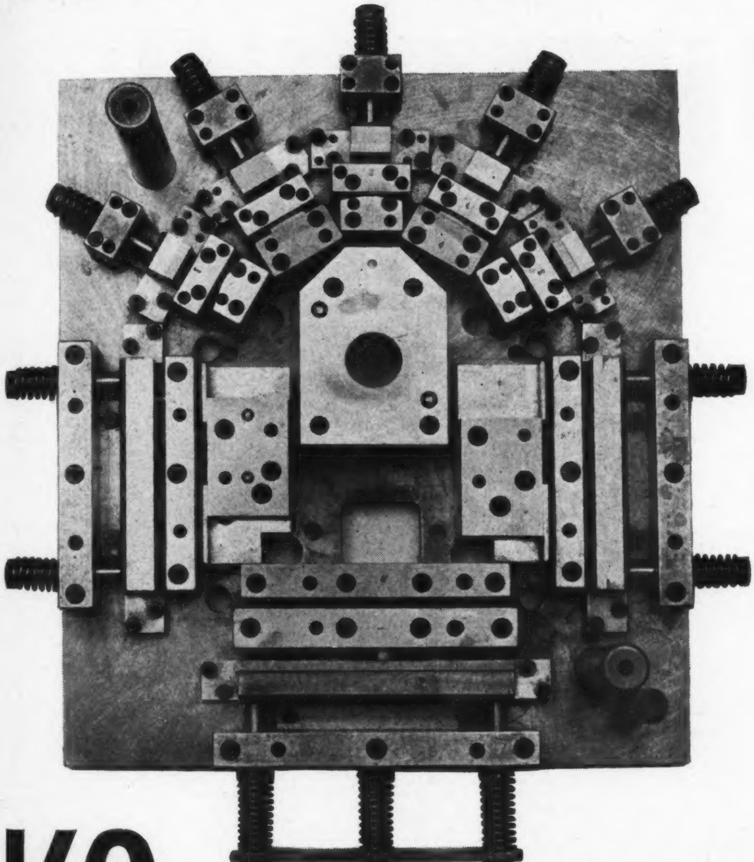
MODELS 53 & 61. 16 universal head spindle speeds. 21-1600 r.p.m.; 8 horizontal spindle speeds 21-1180 r.p.m.; 8 automatic feeds ½-18½in.
MODEL 59. 36 universal head spindle speeds 14-1780 r.p.m.; 12 horizontal spindle speeds 21-1180 r.p.m.; 16 automatic feeds ½-20in.
MODEL 54. Automatic cross feed of universal head 20in.; 18 universal head spindle speeds 12-1500 r.p.m.; 36 horizontal spindle speeds 6-1500 r.p.m.; 18 automatic feeds $\frac{1}{16}$-23½in.

Type	Table	Automatic Feeds Long.	Cross	Vert.
53	43[illegible]in. × 9[illegible]in.	27[illegible]in.	9[illegible]in.	15[illegible]in.
61	47[illegible]in. × 10[illegible]in.	30[illegible]in.	9[illegible]in.	15[illegible]in.
59	51[illegible]in. × 11[illegible]in.	34[illegible]in.	11[illegible]in.	21[illegible]in.
54	67in. × 14[illegible]in.	43[illegible]in.	14[illegible]in.	20[illegible]in.

Send for full particulars of our very extensive range of these machines; ask for demonstration.

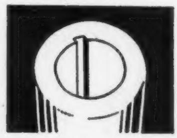
Rudolph Carne & Co. Ltd. SWAN WORKS, FISHERS LANE, CHISWICK, LONDON, W.4.

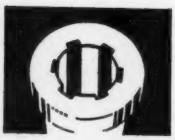
Tel: CHISWICK 0514, 6585, 0337. Inland Telegrams: RUDCAR, CHISK, LONDON. Overseas Telegrams: RUDCAR, LONDON. W.4.



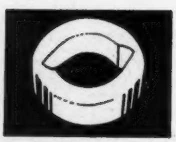
STUHLMANN

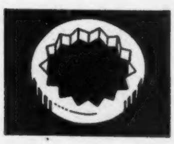
INTERNAL KEYSEATING MACHINES





Simplicity of tooling.
No limit to diameter of workpieces.
No marking out of components.
Simultaneous cutting of several components.
Automatic cut-out upon reaching full depth of slot.
Automatic tool withdrawal.
Small floor space needed.





Model NZH 100

The New Model NZH 100

Hydraulically operated, for cutting grooves up to 4" wide, in bores up to 20" dia. in 3 sizes of length of stroke.

Model NZH 100/500 — 20"
/650 — 26"
/800 — 31½"

Infinitely variable speeds and adjustable drawing power.

SOLE SELLING AGENTS FOR U.K.

Model NZ 250 S with 10" max. length of stroke.

Model NZ 320 S with 12" max. length of stroke.

Mechanically operated for cutting grooves up to 1½" wide, in bores up to 12" dia.

Model NZ 320 S ex-stock subject to prior sale.

THE SELSON MACHINE TOOL CO. LTD.

SUNBEAM ROAD, LONDON, N.W.10 Tel: Elgar 4000

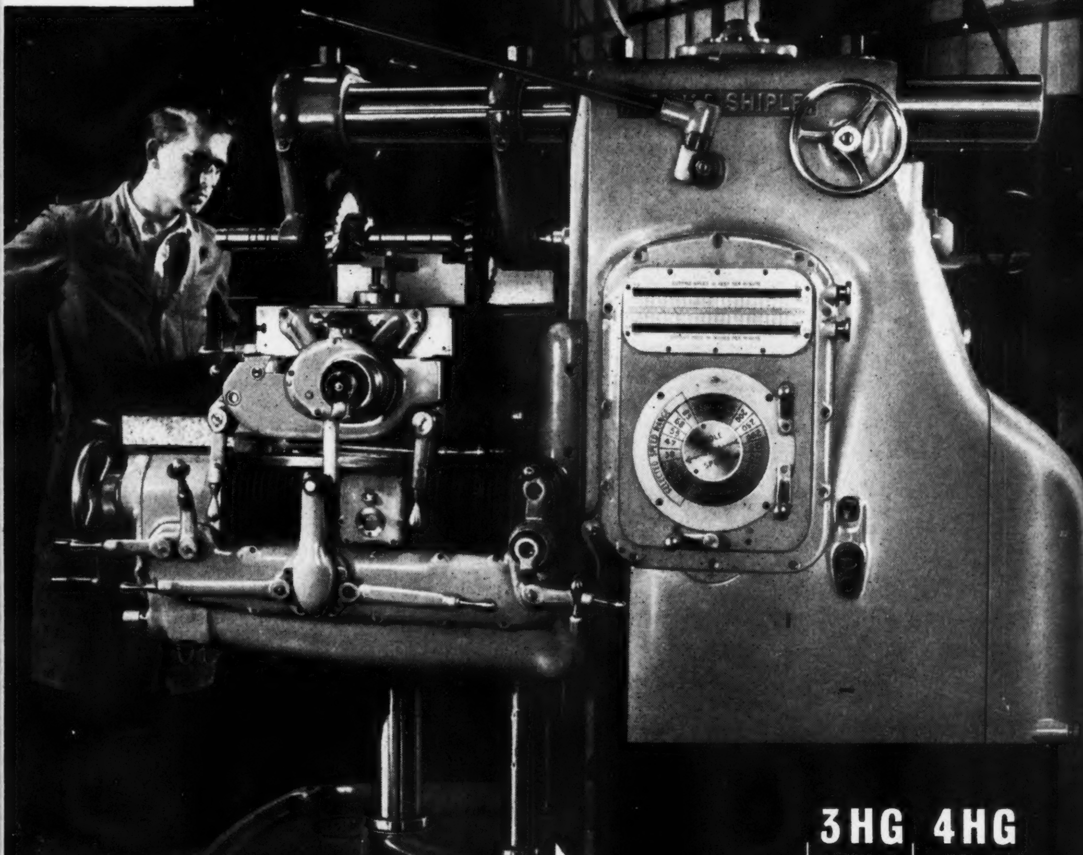
STANNINGLEY Near LEEDS Tel: Pudsey 2241

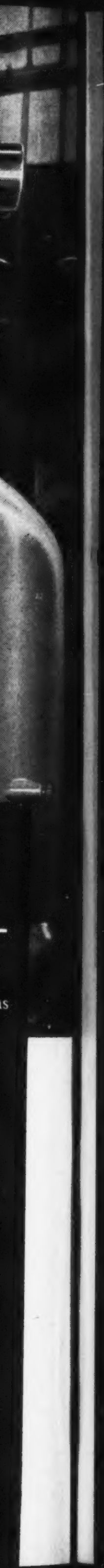
BELL STREET, WEST BROMWICH Tel: West Bromwich 2634

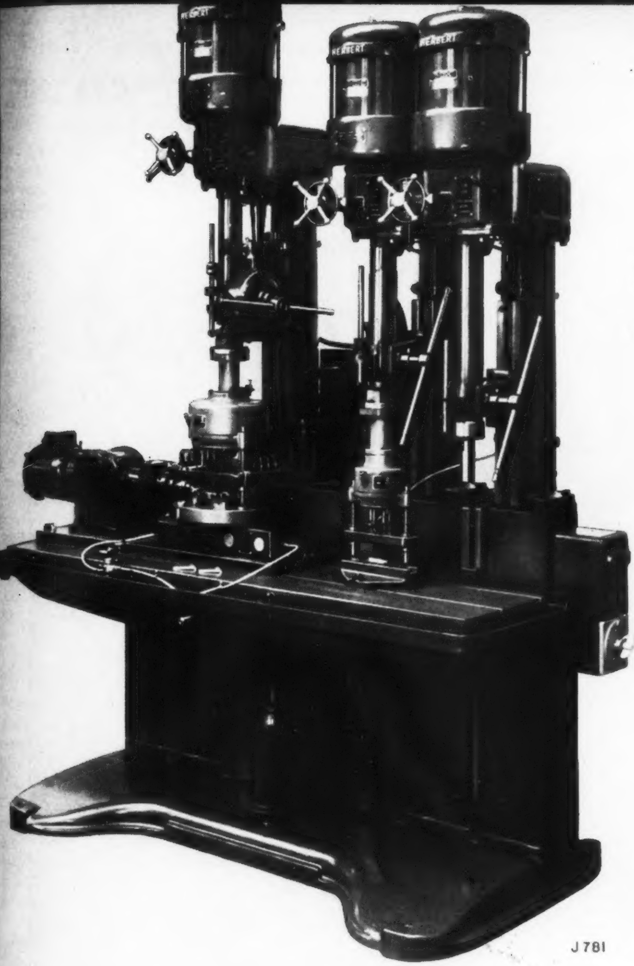
Selson MACHINE TOOLS

THE 600 GROUP

And at: Kingsbury (Nr. Tamworth), Manchester, Glasgow, Swansea, Newcastle-on-Tyne, Sheffield, Southampton, Belfast, Bath







J 781

Unit construction of Herbert Drilling Machines makes it possible to produce a very wide range of machines without resource to specialization except in assembly.

The range is sufficiently extensive to meet the demand for most general-purpose machines and to provide a basis from which to build special-purpose machines with equipment of jigs, tools and fixtures for continuous high production.

We will quote for suitable equipment for dealing with specific work.

Standard Herbert Drilling Machines are made in ten types for drilling and tapping up to 1¼-in. Multi-spindle and Turret-type machines also available.

The World's Largest Machine-tool Organisation presents "Production in Pictures"

The ultimate object of the machine-tool maker is to sell, not only machines, but production.

Excellence of design is an indisputable but only partial contribution; it is complementary to the ability of the maker to provide an efficient service which will enable his customers to obtain the best results from the machines installed. He must be able to advise on methods of production, to design and supply tools, jigs and fixtures, to recommend appropriate feeds and speeds for various materials and operations.

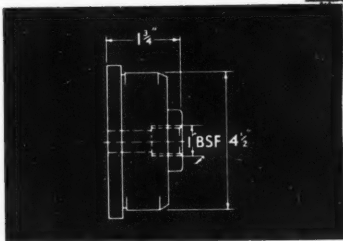
This is a service we offer with great success; we have been doing it for over 60 years for all branches of the engineering industry.

We can supply practically any type of machine tool.

We can equip complete plants.

PRE-SET LATHE TOOLING

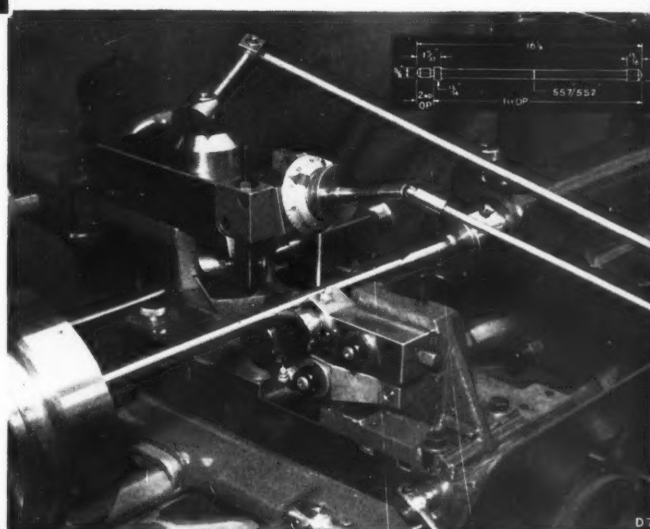
Machining pulley blanks from EN. 8 steel billets on a Herbert No. 3 Capstan Lathe; machining time 6 minutes. The quick-acting square turret and toolholders on the turret are modified for pre-set tooling which permits the unskilled to replace worn tools without recourse to the setter and which reduces " down time ".



HERBERT

A CENTRE AND COPY-TURNING LATHE

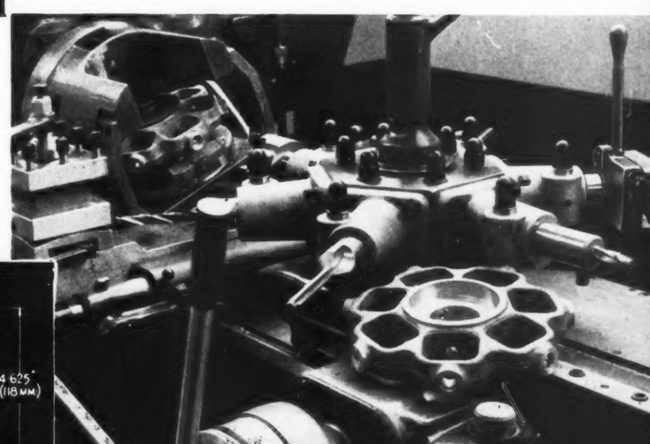
The Herbert Carbijunior, for work up to 3¼" diameter × 22½" long, can be used as an ordinary centre lathe or a high-production copying lathe. The initial one-off can be used as the master. Victory Engineers Ltd. informed us that their Carbijunior dealt, in two days, with two weeks' production relative to previous machining methods. An outstanding time saving effected was in machining broaches, 22" long, with ten cutting teeth and four burnishing teeth; each broach was completely copy-turned in a floor-to-floor time of 12 minutes. Using expensive form tools on a Capstan Lathe, machining time was 52 minutes. The illustration shows the production of a stud from 1⁵⁄₁₆" diameter bright drawn steel bar; two operations are done in 2¼ minutes.



HERBERT

EFFICIENT LATHE PRODUCTION

Tooling and indexing fixture on a Herbert No. 4 Senior Preoptive Capstan Lathe for facing, drilling, boring, reaming and grooving seven radially-spaced bores in an aluminium casting, at one setting. Floor-to-floor time, 28 minutes.



Introducing the new **LANDIS-MAIDEN** double spindle Threading machine

Hardened and ground replaceable bedways.

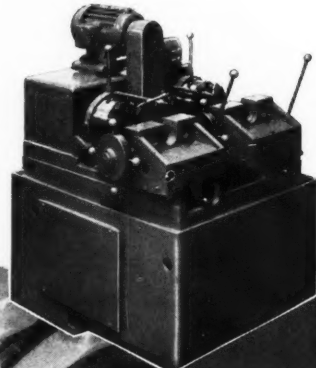
Carriage front adjustable in both vertical and horizontal directions.

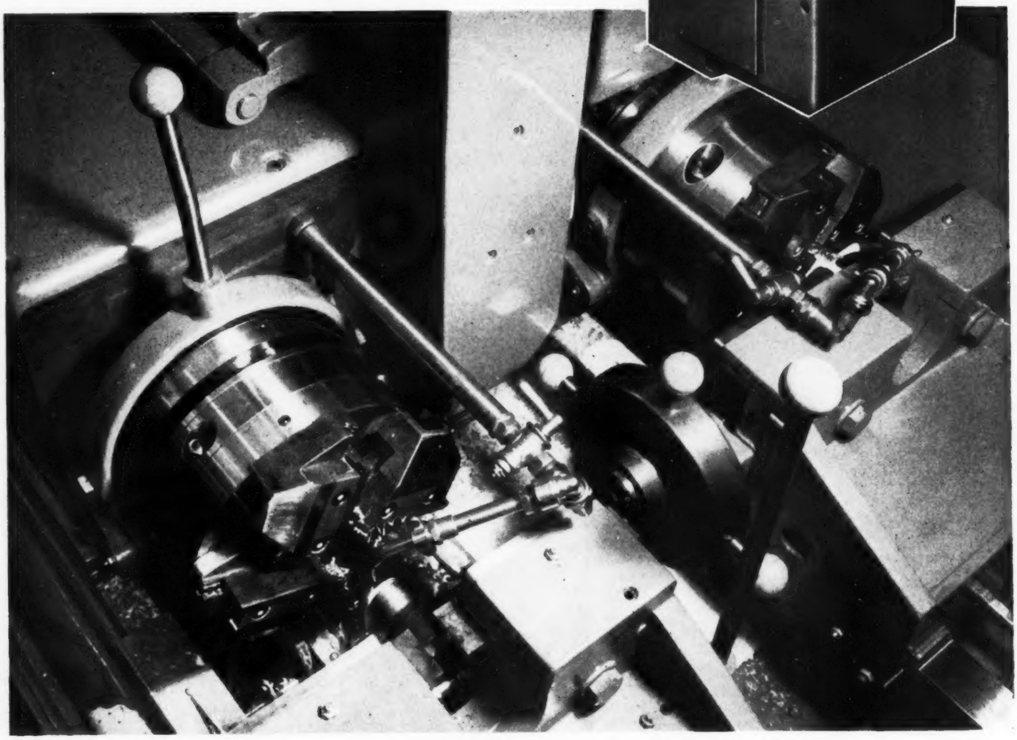
Hammer-blow handwheels give maximum grip and eliminate fatigue.

Spindles may be run at different speeds; 8 speeds by pick-off gears.

For threading bolts and pipes up to $1\frac{1}{2}''$ dia., pipes up to 2″ bore.

Fitted with genuine Landis Tangential Dieheads and Ground-thread Chasers.

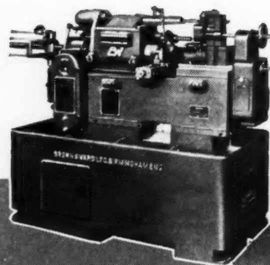




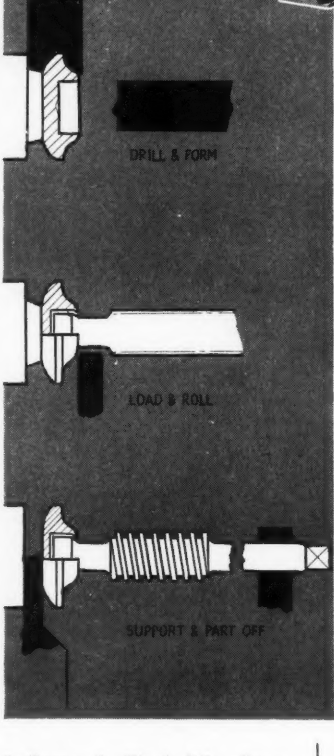
Cutting a 11 t.p.i. B.S.P. taper thread, ream and chamfer 1″ close nipples in a floor-to-floor time of 12 seconds for both ends.

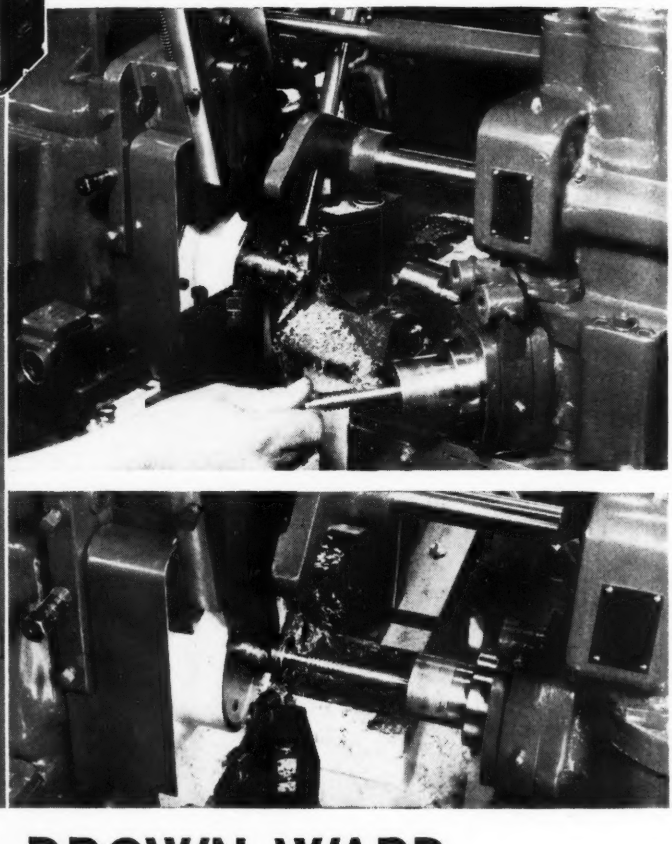
LANDIS MACHINE-MAIDEN LTD
HYDE - CHESHIRE

Sole Agents
ALFRED HERBERT LTD COVENTRY



simplicity of repetition machining on —





A Brown & Ward 1¼in. four-Operation Bar Automatic produces brass clack valves at the rate of 3.6 components per minute.

After the forming and drilling, the machined stem is loaded into the loading head on the turret and inserted in the valve body.

The wall of the valve head is peened over the edge of the stem, prior to parting-off.

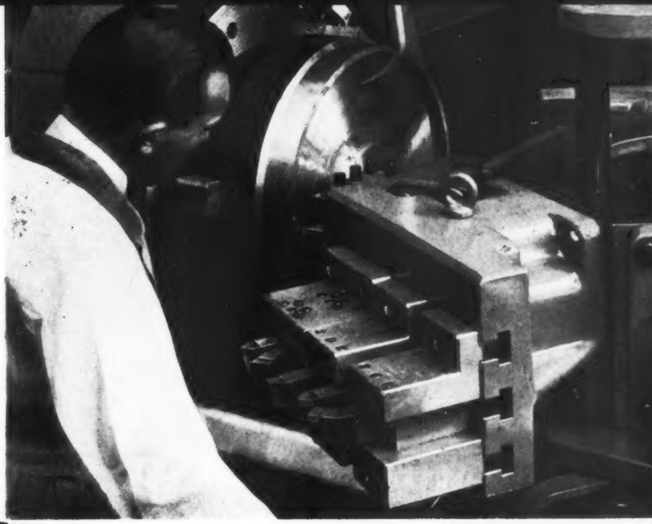
BROWN & WARD

single-spindle BAR AUTOMATICS

Uses simple standard cams and tools.
Wide range of attachments increases versatility,
Competitive to six-station machines relative to low capital outlay.
Six sizes. three types, for work up to 1½in. diameter by 4½in. long,

ALFRED
HERBERT
LTD., COVENTRY *Factored Division, Red Lane Works.*

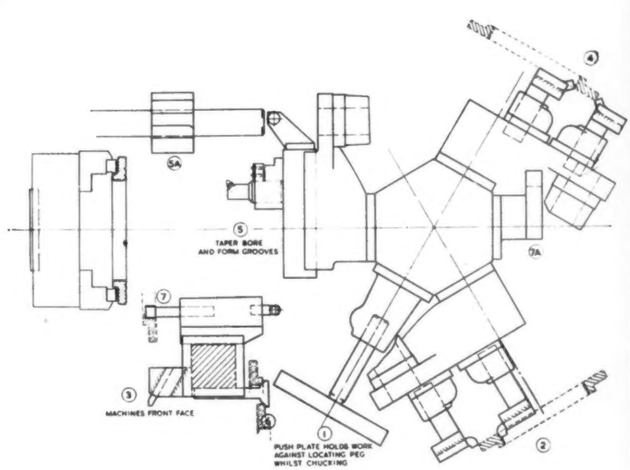
AD 638



HEAVY METAL REMOVAL

Ardoloy-tipped Multi-tooling on a Herbert No. 12B Cross-sliding Turret Lathe—32″ swing, 35/11 h.p. motor. This is the ideal machine for boring and facing with short turning lengths, on work produced in small batches. Extremely heavy metal removal.

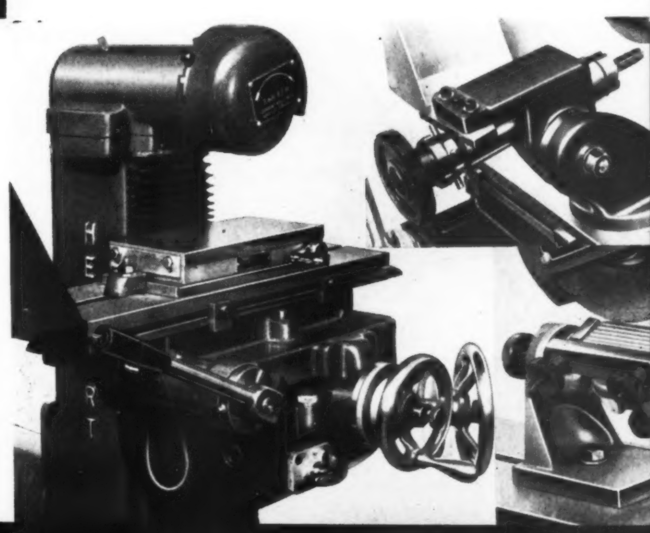
HERBERT



ONE SET-UP MACHINES RANGE OF FLANGES

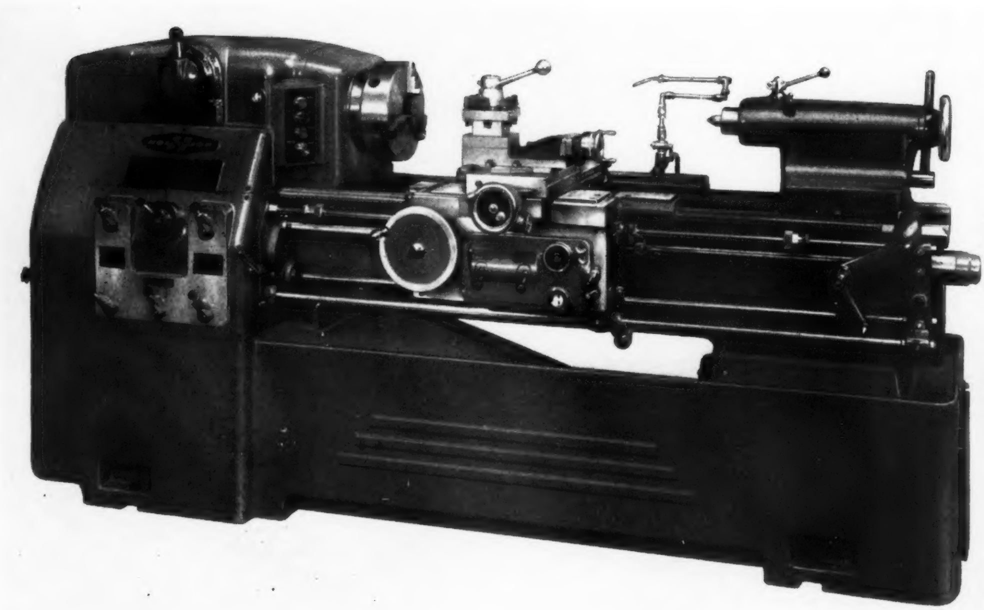
A set-up on a Herbert No. 9C Combination Turret Lathe for machining pipe flanges from steel forgings. Some fifty different sizes and types of flange are machined with only minor adjustments to the tooling. Ardoloy-tipped tools are used throughout.

HERBERT



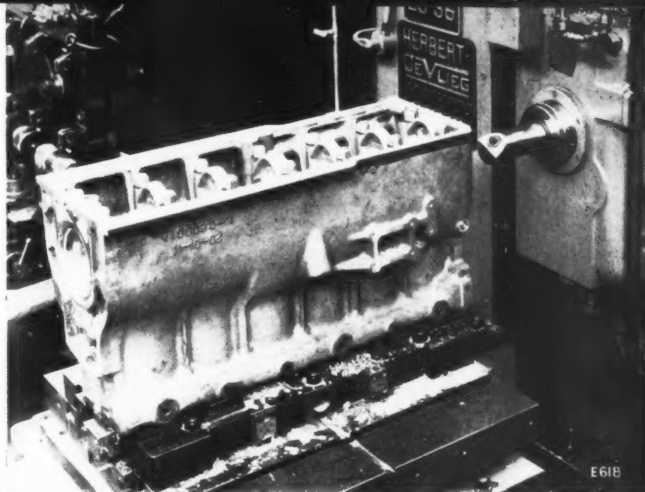
AN ADAPTABLE SMALL SURFACE GRINDING MACHINE

A self-contained 10″ × 4″ × 9″ capacity machine primarily designed and now extensively used for light production jobbing work but which, due to the wide range of tool and cutter grinding attachments available, is now included in most efficient tool maintenance plants. It has micrometer dials for precision control of longitudinal and transverse movements to the table. Pump lubricated covered slide ways.



MAXIMUM OPERATIONS PER SET-UP

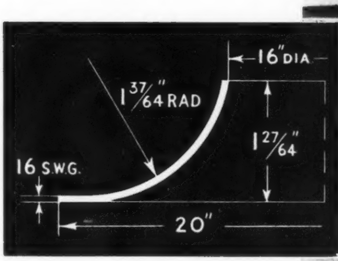
A Herbert/DeVlieg Jigmil completely machines the cylinder block of the 3.7 litre engine for the David Brown Aston Martin DB. 4 sports saloon. Operations include drilling, tapping, boring, counter-boring, line boring, spot facing, back facing and face milling. The Herbert-designed locating fixture is also used for machining the cylinder head. Accurate jigless positioning is obtained with the "Duplitrol" co-ordinate positioning system, which provides rapid batch production and a high machine utilization.

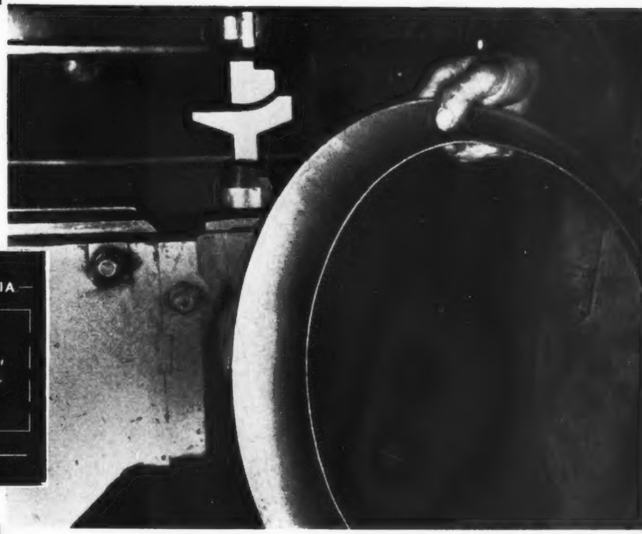


HERBERT

RAPID FORMING OF SHEET METAL

A Pullmax machine forms flat rings into a radiused section, see below, from 16 s.w.g. mild-steel sheet in approx. 15 minutes.

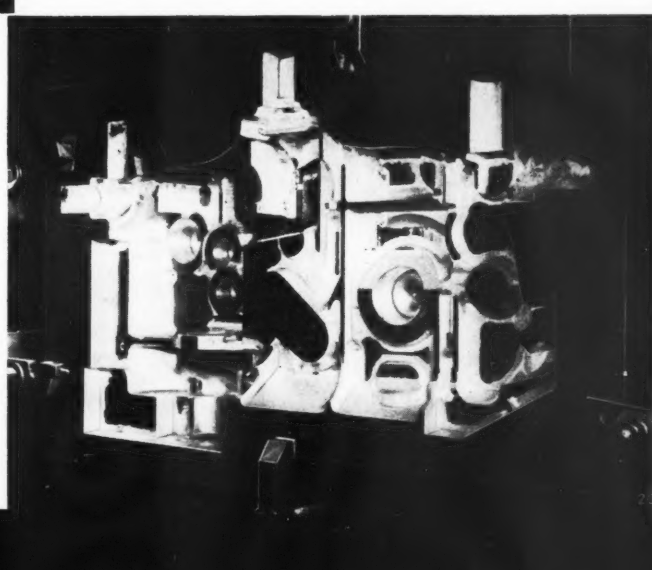




HERBERT

TRACER-CONTROLLED MILLING

The Keller Automatic Toolroom Machine with automatic electric controls, for two- or three-dimensional work on dies and moulds of all kinds, press tools (motor-car roof punches are machined), metal patterns and similar work. Two sizes—5′ × 2½′ and 6′ × 4′—now built in this country by Pratt Whitney & Herbert Ltd. The core box (4′ 6″ × 2′ 6″) shown was automatically machined in a floor-to-floor time of 100 hours. Accuracy was such that the layout ines were split during machining.



Quality for your products starts here ----

...and we can meet your planing capacities with

Double-column Planers with capacities up to 12′ 0″ × 5′ 6″ × 6′ 0″ (Spiral Drive except "Junior" types). Openside All-electric Spiral Drive Planers with capacities up to 10′ 0″ × 4′ 6″ × 4′ 6″. Openside Planer Shaper with capacities up to 96″ × 25″ × 2½″. Can be fitted with Milling, Grinding or Profiling Attachments.

AD 690

planers
HUDDERSFIELD · LIMITED

a member of the HERBERT group

A WELL-ESTABLISHED CENTRE-LATHE

The illustration shows a battery of Edgwick $6\frac{1}{2}''$ Gap-Bed Centre Lathes installed at the Heaton Works of C. A. Parsons & Co. Ltd. The Edgwick Lathe, over 3,700 have been sold during the last 20 years, is designed to accommodate 95% of the centre-lathe work required in industry today.

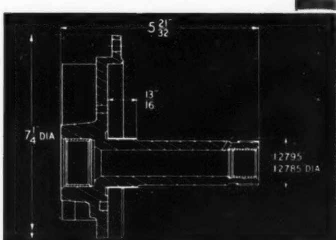
The modern version, designated Mk. II, is available with 6′ 8″ or 7′ 8″ bed length. Swing over bed: 14″. Swing in gap: 22″ × $7\frac{1}{4}''$ 12 speeds 17-670 r.p.m. or 25-100 r.p.m.

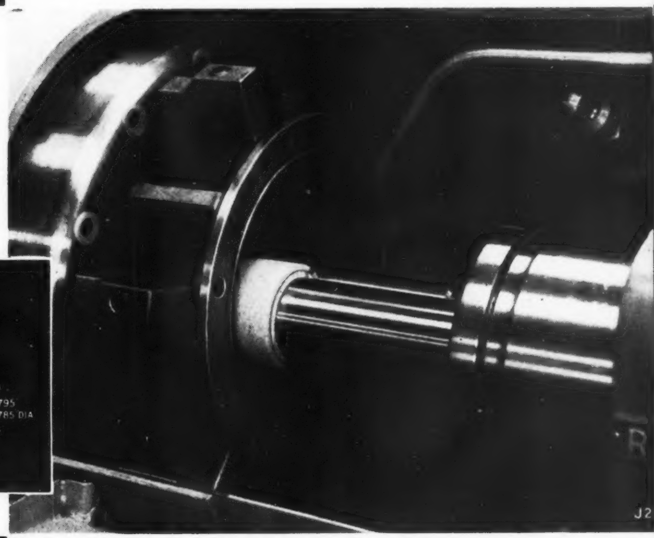
Can be fitted with hydraulic copy-turning attachment.

HERBERT

PRECISION AUTOMATIC GRINDING

Automatic grinding a 1.2785/1.2795″ external diameter on a Heald 171 Sizematic Internal Grinding Machine. Up to fifty components ground per hour (80% efficiency).

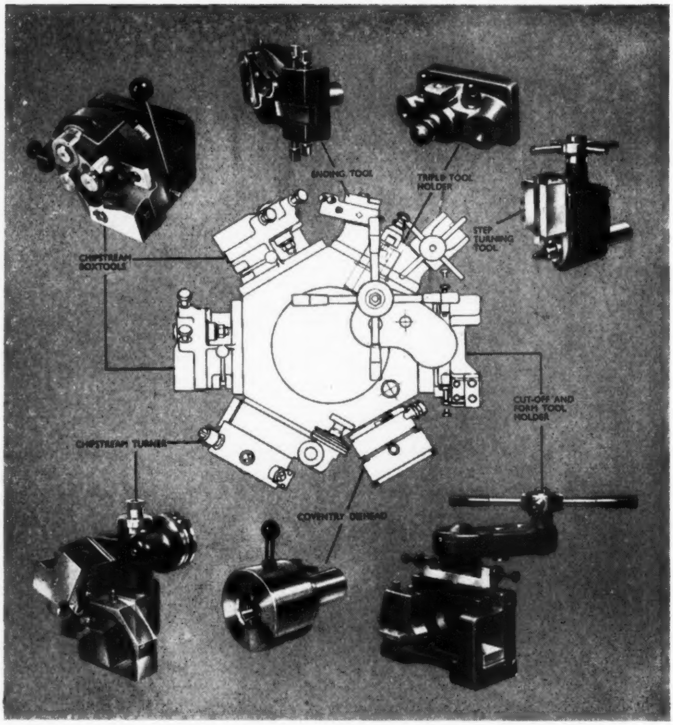




HERBERT

THREAD ROLLING

In-feed rolling and ajustable worm on a Landis Lan-nu-rol Thread Rolling Machine. A $\frac{9}{16}''$ dia., 14 t.p.i., full depth acme thread is produced in 12 seconds.



HERBERT HEXAGON TURRET LATHES

The illustration above shows the standard outfit of tools supplied with these machines and the method of arranging them around the turret.

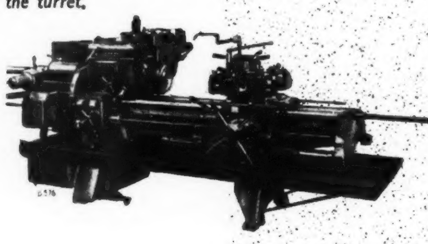
The Hexagon Turret Lathe is essentially for the production of shafts, spindles, pins, bolts, studs, collars, bushes and other work which can be made direct from the bar and thus eliminate the cost of forgings and stampings.

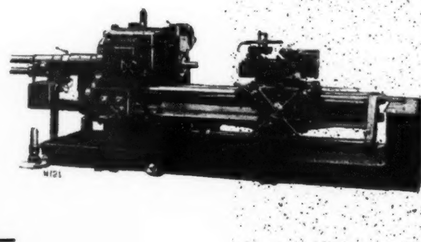
Since bar work operations mainly comprise the machining of various diameters and lengths and the cutting of threads of a restricted range of sizes, there is no necessity for a saddle and practically all operations within the capacity of the machine can be performed with the standard outfit of tools.

Two sizes available to accommodate work up to 3″ diameter by 38″ long.

Both sizes now available for

EARLY DELIVERY





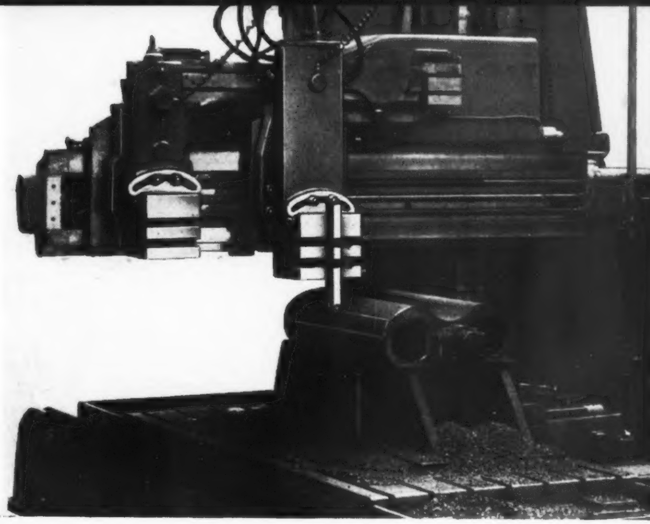
ALFRED HERBERT LTD., COVENTRY

COPYING OPERATION ON A PLANING MACHINE

We are sole agents for the standard and special-purpose reciprocating machines made by Planers (Huddersfield) Ltd.

The illustration shows a Planers 8′ 0″ × 4′ 0″ × 4′ 0″ Openside Planer equipped with a copying toolbox on the cross slide, in addition to one standard-type toolbox. Accurate copying can be done through an angle of 180° with this equipment.

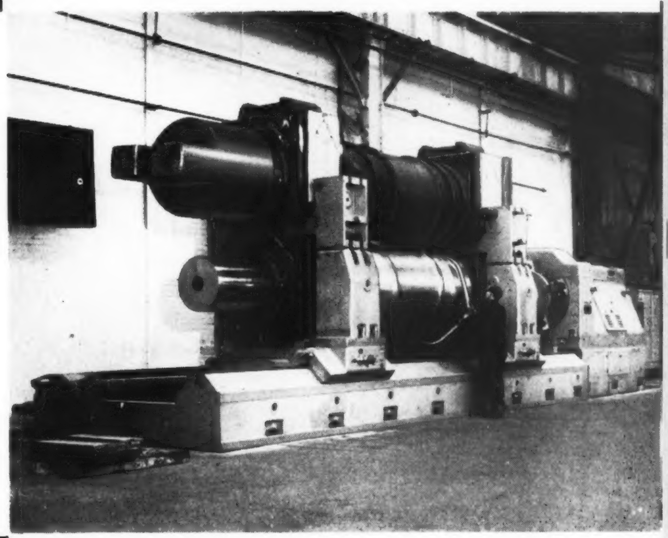
The machine is driven from a 25 h.p. main reversing motor and table speeds from 30-200 ft. per minute, on cutting and return strokes, are available.



HERBERT

TURNING, FORMING AND GRINDING LARGE ROLLS

Waldrich-Siegen Roll Turning Lathes with centre heights from 40″ to 90″ and Roll Grinding Machines with capacities for rolls up to 72″ dia. and of any length restricted to rolls of a maximum weight of 130 tons. Can be specially developed to meet customers' specific requirements for the manufacture of rolls for producing plate, sheet, strips and foil.

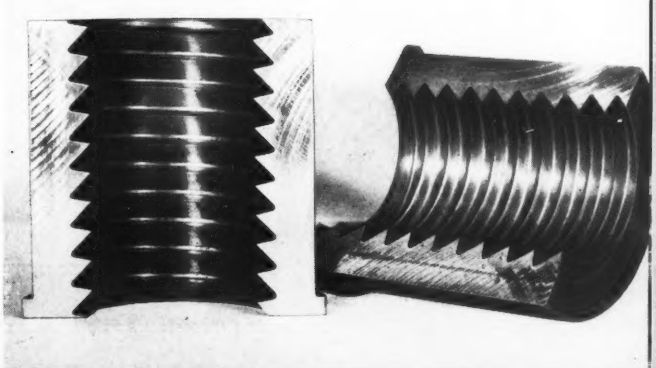


HERBERT

HERBERT GROUND-THREAD TAPS

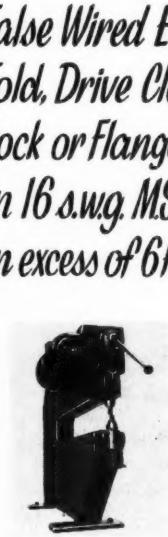
Standard taps in all sizes and forms of thread. Special taps, including those for Acme, Buttress. Knuckle; Staybolt, Mud plug and Tandem taps made to customers' requirements. Accuracy conforms to B.S.I. Specifications, Zones 1, 2 and 3.

The 2¼″ dia. × 3 t.p.i. buttress thread shown, was cut in one pass, in a phosphor-bronze nut with a Herbert Ground-Thread Tandem Tap on a Herbert Combination Turret Lathe.



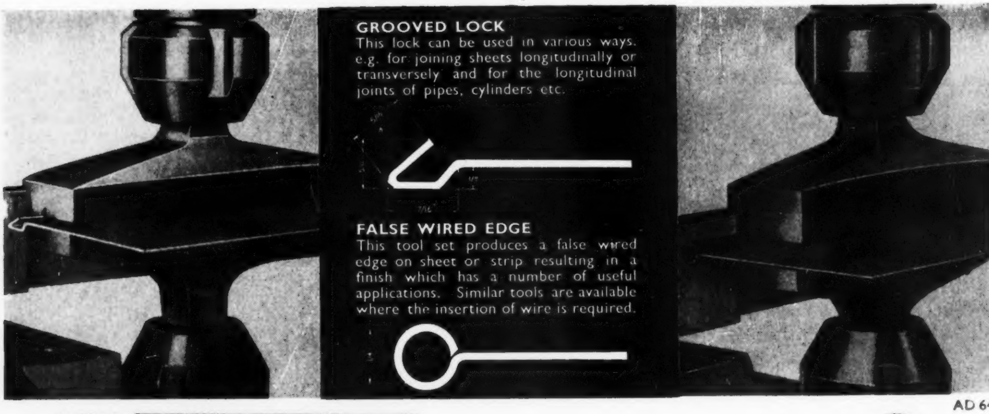
NEW! introducing a series of LOCK FORMING TOOLS to produce a False Wired Edge, Dutch Fold, Drive Cleat, Grooved Lock or Flanged Channel in 16 s.w.g. M.S. at speeds in excess of 6 ft per minute

PULLMAX



SHEET METAL WORKING MACHINES

No modern sheet-metal department is complete without a PULLMAX machine. These versatile machines are designed for cutting circles, louvres, straight edges and internal or external irregular shapes. In addition many forming operations including beading, flanging, doming, joggling, etc., can be performed.

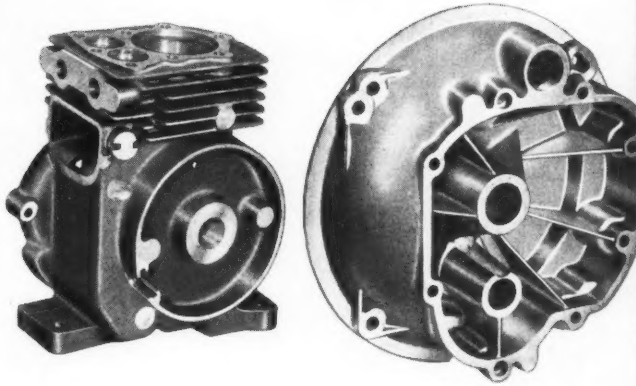


AD 646

ALFRED **HERBERT** *LTD., COVENTRY* *Factored Division, Red Lane Works.*

HIGH-SPEED INSPECTION

Four Sigma Liquicolumn Multi-dimension Inspection machines have been supplied to Villiers Engineering Co. Ltd. for high-speed 100% inspection of crankcases and covers—one of each type shown alongside. Diameters and lengths, relationship and pitch of holes, parallelism and concentricity, squareness, taper and ovality are inspected in various combinations simultaneously.



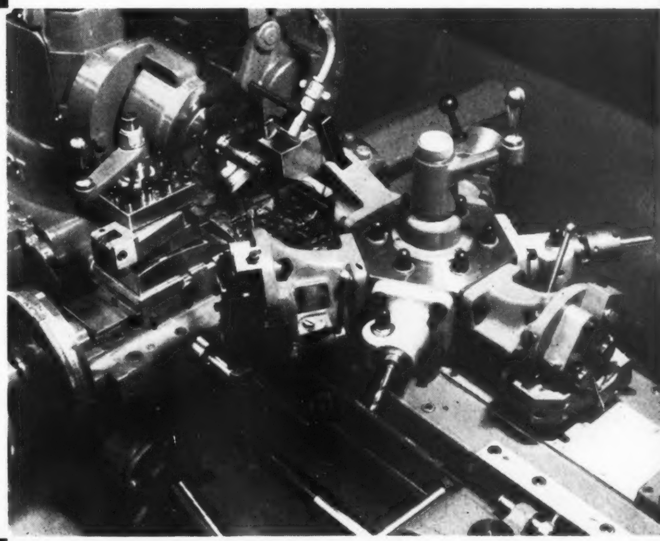
HERBERT

LARGE REDUCTION IN DIAMETER WITH HIGH DEGREE OF SURFACE FINISH

Chipstream Boxtools permit large reductions in diameter in one cut.

In the Herbert works, on day-to-day production, these boxtools provide a relatively high degree of surface finish. Measured readings between 5 to 10 micro inches are frequently obtained. Boxtools with capacities up to 3″ diameter, available.

Two boxtools are used in the set-up on a Herbert No. 2D Capstan Lathe shown alongside



HERBERT

PRECISION PRODUCTION BORING

Microbores micrometer adjustable single-point Ardoloy-tipped tools—in a cluster on a milling machine, machining three bores and the top face of a gearbox casing. Machining is done direct from the cored holes and sizes, parallelism and ovality held to within close tolerances. The largest diameter, for instance, is machined parallel to within 3.7496/3.7493″.

The finish obtained eliminated a subsequent grinding operation necessary prior to the use of Microbore Tooling.

We can supply a wide range of Small Tools and Machine-shop Accessories, most of which have been proved in our own Works.
What is more important, they can be supplied promptly, for a comprehensive range of tools is stocked not only at our Coventry Warehouse (a section of this is pictured above) but also at Branch Offices at:—

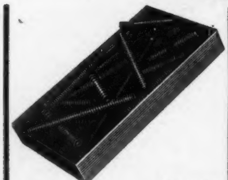
LONDON, MANCHESTER, LEEDS, BIRMINGHAM, SHEFFIELD, BRISTOL, NEWCASTLE AND GLASGOW.

ALFRED HERBERT LTD., COVENTRY

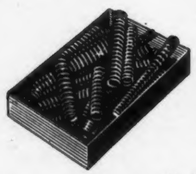
AD 686

EXPERIMENTAL SPRINGS?

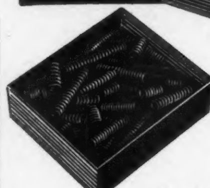
Don't grope here...



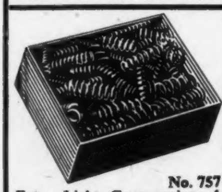
No. 1200
Three dozen Assorted Light Expansion Springs, suitable for carburettor control, etc. 15/-.



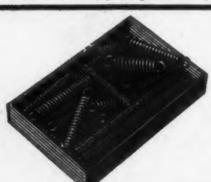
No. 760
Three dozen Assorted Light Compression Springs. 1" to 4" long, 22 to 18 S.W.G., $\frac{1}{4}$" to $\frac{1}{2}$" diam. 7/6.



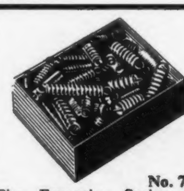
No. 98A
Three dozen Assorted 1" to 4" long, $\frac{1}{4}$" to $\frac{3}{4}$" diam., 19G to 15G. 6/6.



No. 757
Extra Light Compression, 1 gross Assorted, $\frac{1}{8}$" to $\frac{7}{16}$" diam., $\frac{1}{4}$" to $2\frac{1}{4}$" long, 27 to 19 S.W.G. 18/-.



No. 753
Three dozen Assorted Light Expansion $\frac{1}{4}$" to $\frac{1}{2}$" diam., 2" to 6" long, 22 to 18 S.W.G. 12/-.



No. 758
Fine Expansion Springs. 1 gross Assorted $\frac{1}{8}$" to $\frac{3}{8}$" diam., $\frac{1}{2}$" to 2" long, 27 to 20 S.W.G. 18/-.

That spring you want . . . in a hurry . . . where is it? Pick what you want, when you want it, from TERRY'S BOXES OF ASSORTED SPRINGS—our fine range of small boxed assortments of experimental springs. We can show you only a few from the range here. Send a postcard for our full list—and if ever you're stuck with a spring problem send it along to our Research Department—they'll gladly help you out.

Have you a Presswork problem?

If so, the help of our Design Staff is yours for the asking.

TERRY'S
for SPRINGS

Really interested in Springs? "Spring Design and Calculations" 10th Edition tells all—post free 12/6.

Cut Production Costs with Terry's Wire CIRCLIPS. We can supply immediately from stock — from $\frac{1}{8}$" to $\frac{3}{8}$".

Looking for good Hose Clips? Send for a Sample of Terry's Security Worm Drive Hose Clip and price list.

HERBERT TERRY & SONS LTD.
Redditch, Worcs.

(Makers of Quality Springs, Wireforms and Presswork for over 100 years.)

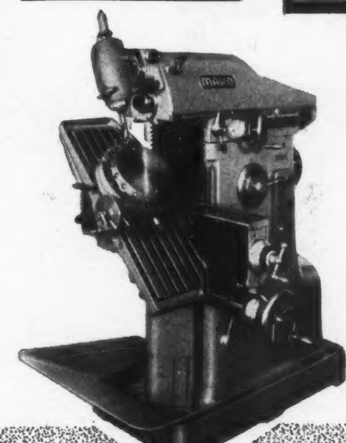
HT310

Visit the **MACHINE TOOL EXHIBITION**
at our extended Showrooms
11-15 DECEMBER

MMT

MAHO

THE MOST COMPLETE RANGE OF UNIVERSAL JIG MILLING AND DIESINKING MACHINES



These Four Universal Tool Milling and Diesinking Machines cover the requirements of all toolrooms large and small. Absolute versatility is provided by unique construction and extremely wide range of auxiliary equipment, including optical co-ordinate setting for jig boring. This range enables tools to be machined up to approximately one ton in weight.

CHECK YOUR TOOLROOM REQUIREMENTS AGAINST THESE MODELS

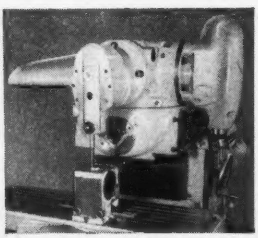
MAHO MH.600. Table 24" x 8⅝", horizontal spindle speed 55 - 1000 r.p.m., vertical spindle speed 99 - 1650 r.p.m.

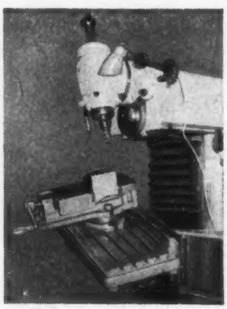
MAHO MH.700. Table 27½" x 10¼", horizontal spindle speed 65 - 1000 r.p.m., vertical spindle speed 99 - 1650 r.p.m.

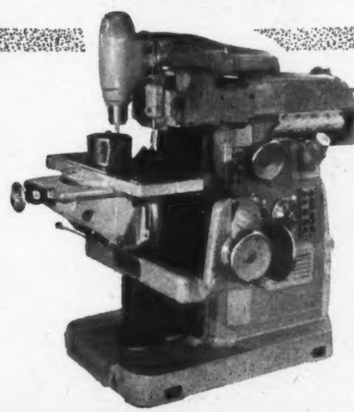
MAHO MH.800. Table 31½" x 12½", horizontal spindle speed 32 - 1320 r.p.m., vertical spindle speed 45 - 1900 r.p.m.

MAHO MH.1000. Table 47¼" x 14½", horizontal spindle speed 40 - 2000 r.p.m., vertical spindle speed 40 - 2000 r.p.m.

Models MH.800 and MH.1000 are equipped with independent spindle drive motors mounted on ram.







OPTIONAL EXTRA ACCESSORIES INCLUDE . . .

High speed vertical milling heads, slotting attachment, rotary table, fixed swivelling, tilting and inclinable tables, punch milling attachment, dividing head and spiral milling attachment, and on the larger models power fed vertical milling attachment will be available. It is also possible on the MAHO model MH.800 to fit this machine with hydraulic copying equipment, and on the model MH.1000 HEID electronic copying equipment is available.

Optical readers and rules can be supplied for the headstock slide, longitudinal traverse slide and vertical traverse slide.

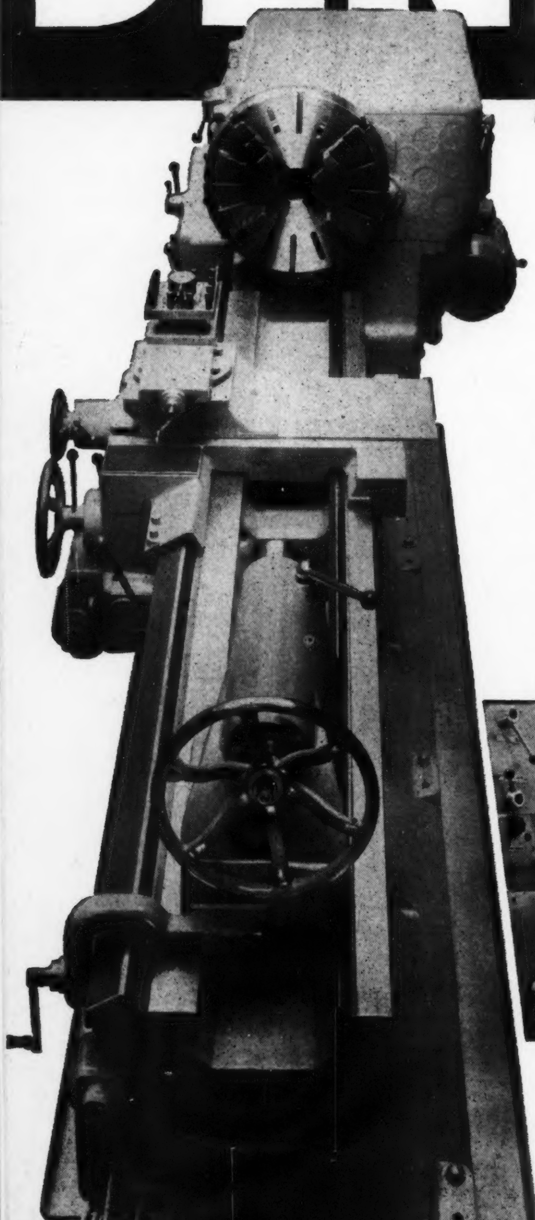
SHOWROOMS & SALES OFFICES:
MORTIMER MACHINE TOOL CO. LTD.
MORTIMER HOUSE, ACTON LANE
LONDON N.W.10. Tel: ELGAR 3834

MORTIMER
EXCLUSIVE DISTRIBUTORS OF THE FINEST MACHINE TOOLS

NRP 5083

DENHAM

CENTRE LATHES



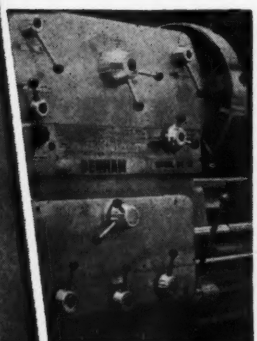
MODELS

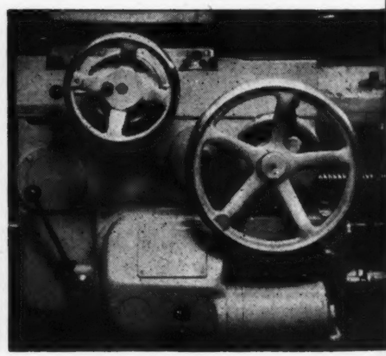
BV. 28 — 29 in
BV. 32 — 32 in ***Swing over bed***
BV. 36 — 37 in

- 24 speed headstock
- 4.9-400 or 7.5-600 r.p.m.
- Helical final drive to spindle
- 48 change feed screwcutting gearbox

Optional extras include:

- 12 belt spindle speeds of 100-800 r.p.m.
- Power feed to 360 deg. swivelling tool-slide
- Quick power traverse of carriage and cross-slide





Manufacturers of:

Centre Lathes from 17″ (430 mm) to 42″ (1065 mm) Swing
Surfacing and Boring Lathes of 17″ (430 mm)
and 25″ (635 mm) Swing

TAS/CC.92

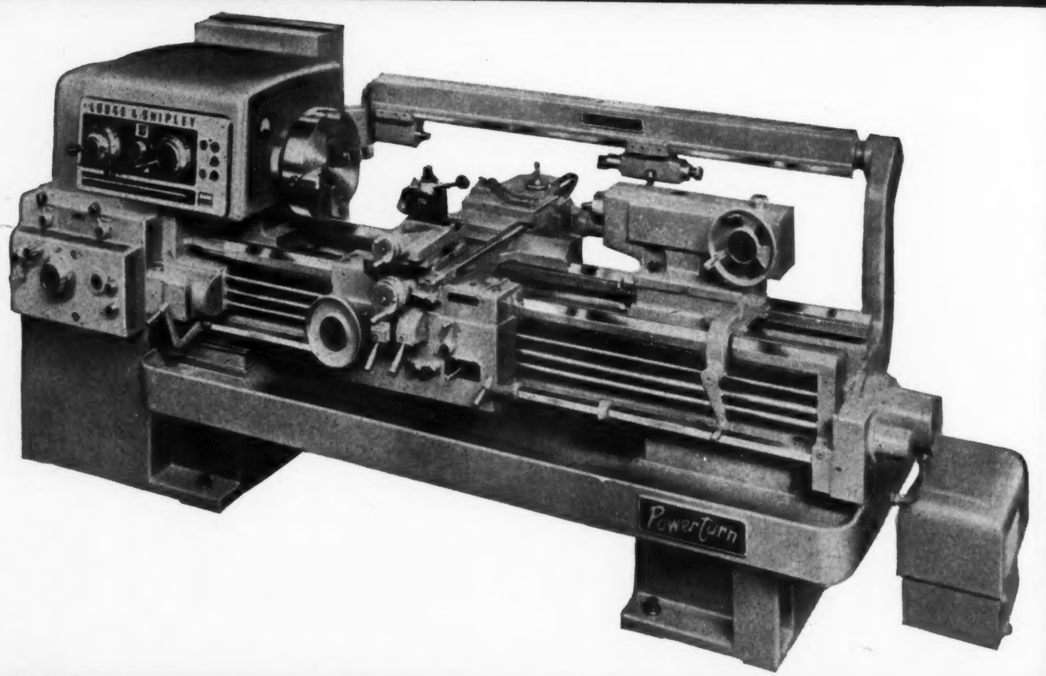
DENHAM'S ENGINEERING CO. LTD., HALIFAX, ENG.

Member of the Charles Churchill Group of Companies

Dec. 13, 1961 Suppl. 58

LODGE & SHIPLEY

Powerturn



... a new standard in a

The ROHM HYDRAULIC FACE DRIVING UNIT

ROHM CONSTANT

SPECIAL ADVANTAGES:

- Easy handling of large diameters.
- Easy and quick exchange of driving pins without the use of any mechanical means.
- Every driving plate forms a complete hydraulic unit. The driving pins can be exchanged without loss of hydraulic fluid.
- Absolutely true and concentric run of the workpiece.
- Highest possible degree of axial and radial rigidity.

ROHM AUTOMATIC 'C'

SPECIAL ADVANTAGES:

- Any expansion caused by heat is automatically compensated.
- It is not necessary to watch the pressure gauge during turning.
- End pressure being constant, there is a certainty of efficient drive by the face driving unit.
- No shape alteration of the workpiece due to bending, side thrust, etc.
- No possibility of overloading the machine — or centre bearings.
- Considerable saving in operation time.

★ ***Powerful driving without chucking***

★ ***Full length of component completely unobstructed***

Five standard sizes

Complete details on request

Main U.K. Distributors for ROHM Face Driving Units:

CHARLES CHURCHILL & CO LTD.,
Coventry Road, South Yardley, Birmingham,
and all Branches

Sole Importers for the United Kingdom

MICHAEL S. THOMPSON LTD.

185/7 HAMMERSMITH ROAD LONDON W.6

***Telephone* RIVerside 7922/3** ***Telegrams* TOMTOOL, LONDON W.6**

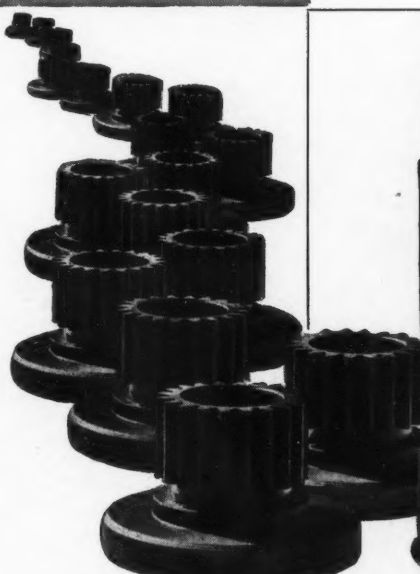
Talk to Sykes about the V10B

41 gears in 59 minutes

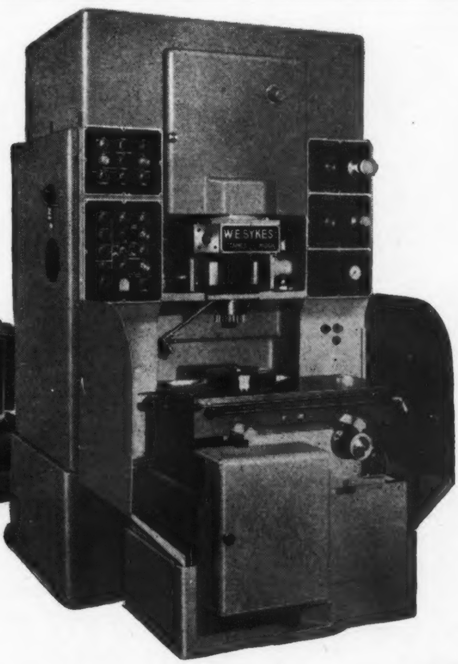
V10B

. . . you would probably be quite satisfied if you produced these 41 gears in the time stated. With the V10B Vertical Gear Generator (Basic model) we promise you more than that . . . you can set the machine, size the first gear and cut the remainder of the batch . . . in less than an hour.

If you would like to know more about the remarkable savings which the V10B can effect on setting and cutting times on batch production write for a copy of brochure P18/60.



22 teeth, 16 D.P. 13/16 in. face width, E.N.8. Steel.



SYKES

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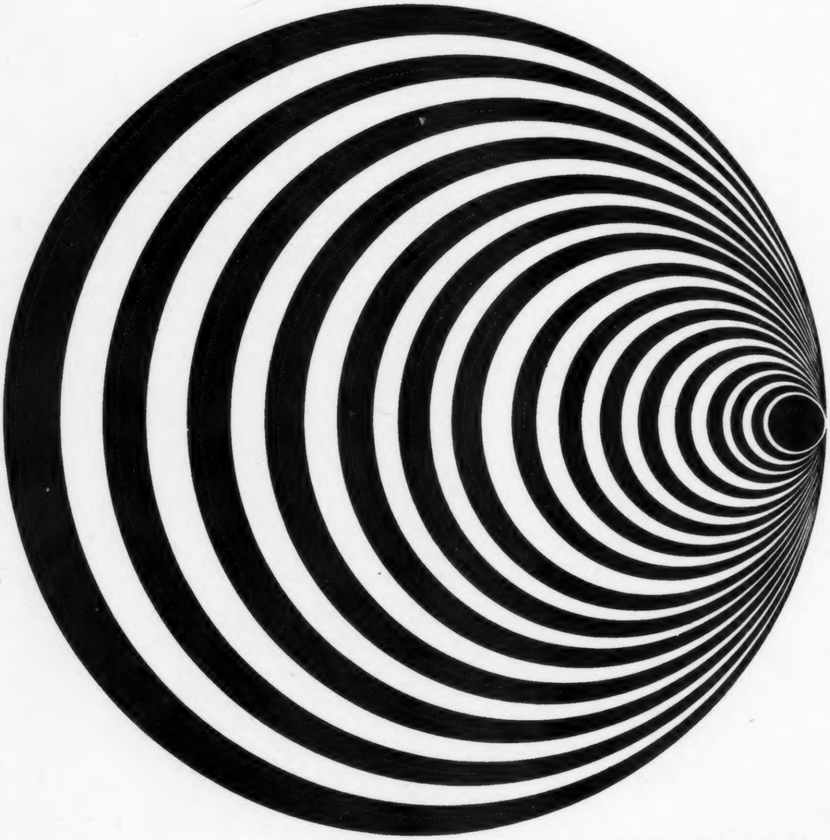
and associated companies:

Sykes Tool Corporation Ltd., Windsor, Ontario, Canada. Sykes Machine & Gear Corporation, Detroit, Michigan, U.S.A. W. E. Sykes Ltd., Mascot, Sydney, NSW, Australia.



INCREASE YOUR PRODUCTION CAPACITY

Automatic or semi-automatic machinery increases production and reduces costs, and Martonair pneumatic equipment has been the means of building thousands of machines. Low cost, adaptability and simplicity are special features of Martonair products. If there is no machine available for the operation you wish to mechanise, or existing machines are for some reason unsuitable, it may well be possible to build a simple special purpose machine. The Martonair Technical Service is at your disposal at all times, and has considerable experience of the applications of pneumatics in industry.

Martonair

The FIRST name in applied pneumatics

MARTONAIR LIMITED, PARKSHOT, RICHMOND, SURREY, ENGLAND.
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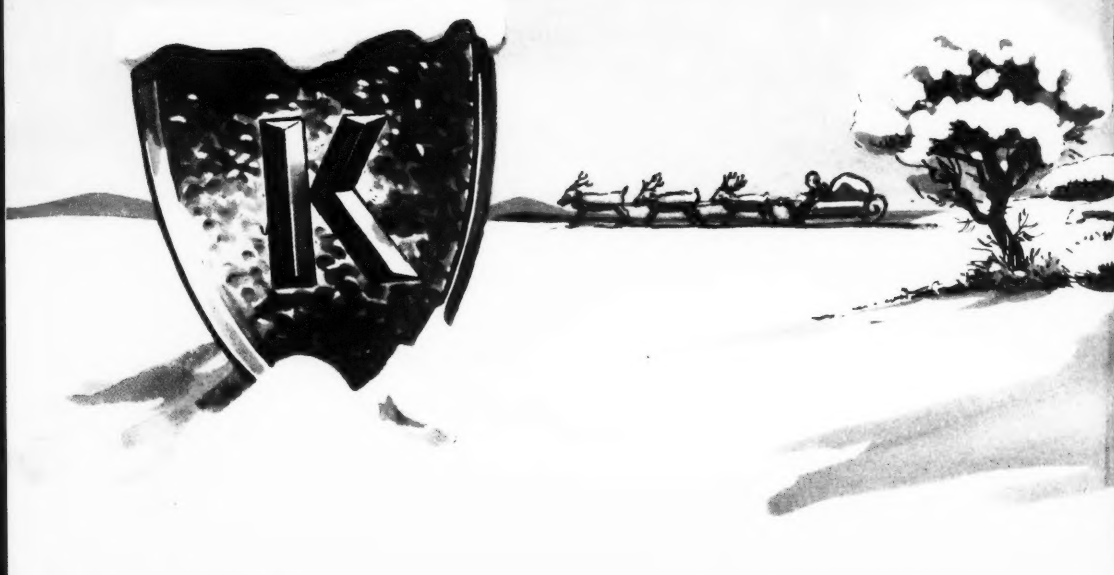
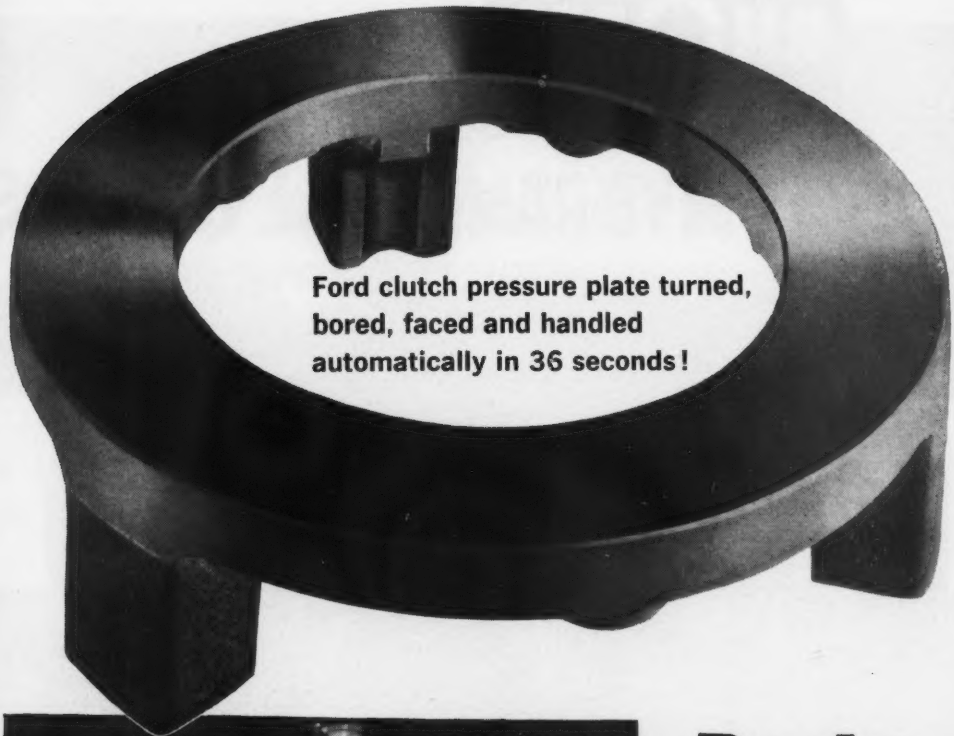
KEARNS

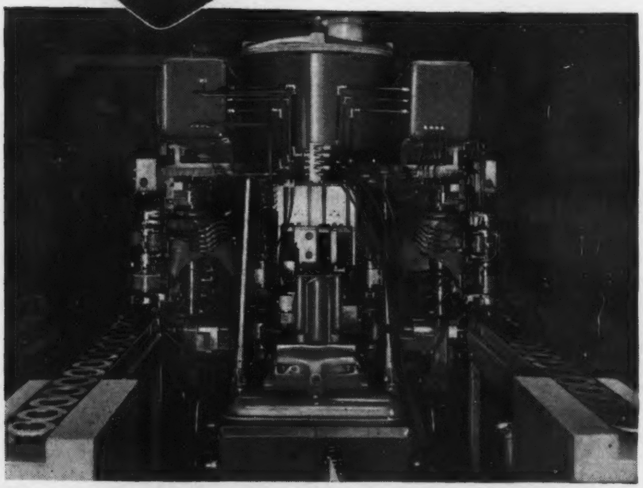
of Broadheath
wish you a
Merry Christmas
and all the best for
1962



H. W. KEARNS & CO. LIMITED BROADHEATH Nr. MANCHESTER

Horizontal Surfacing, Boring & Milling Machines





Ryder

does it this way . . .

Ford use the standard RYDER No. 8 VERTICALAUTO with double auto-handling to produce two components per cycle. Here is a system that gets right to the heart of higher overheads, providing the production scope of special equipment on a standard machine.

RYDER VERTICALAUTOS suitably adapted for automatic handling can cut your production costs too.

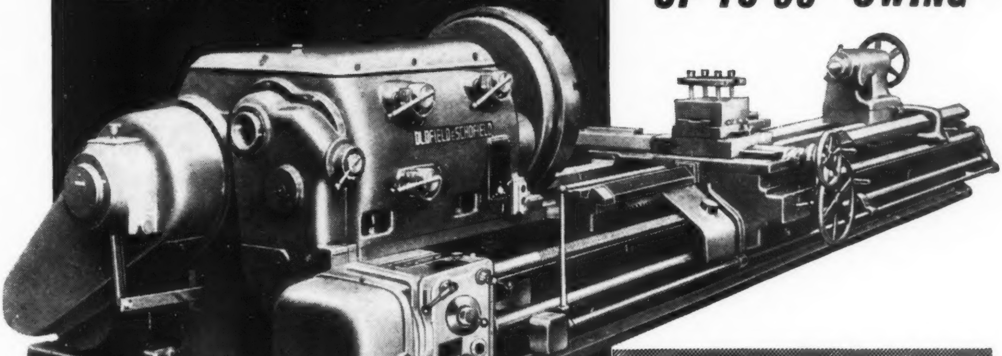
THOMAS RYDER & SON LIMITED,
TURNER BRIDGE WORKS,
BOLTON, ENGLAND.

See Ryder about automatics and auto-handling

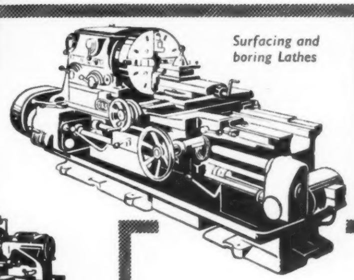
961

Heavy Duty LATHES

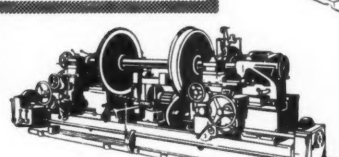
UP TO 96" SWING



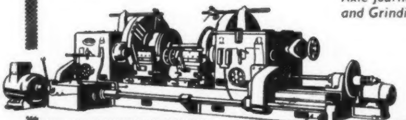
18½" Centre 'D' Type Lathes. Built in sizes up to 48" swing.



Surfacing and boring Lathes



Axle Journal Turning and Grinding Machines



Heavy Duty Double Wheel Lathe

O & S have for many years manufactured a wide variety of heavy lathes which have earned for the company a fine reputation for precision engineering and first class craftsmanship. The range includes Surfacing and Boring Lathes up to 96" swing, Brake Lathes, Axle Lathes, railway carriage and waggon wheel lathes, axle journal turning and burnishing lathes etc., all embodying the latest developments in modern lathe design.

manufactured within the KERRY GROUP by

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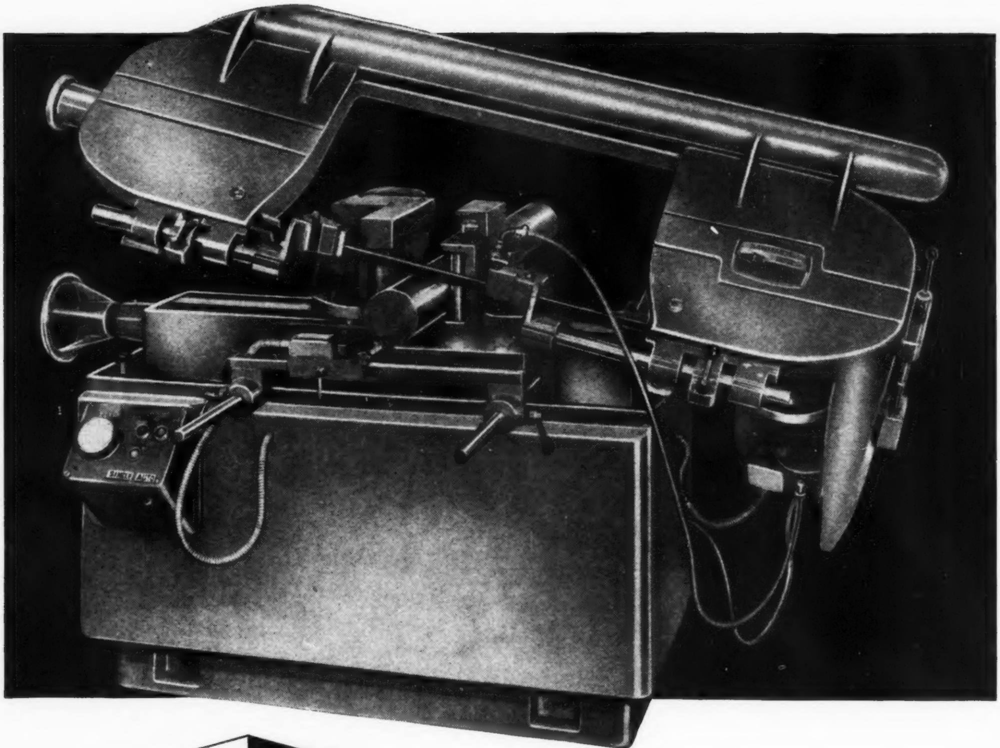
Sales Office: WARTON ROAD, STRATFORD, LONDON, E.15. Telephone: MARyland 6611



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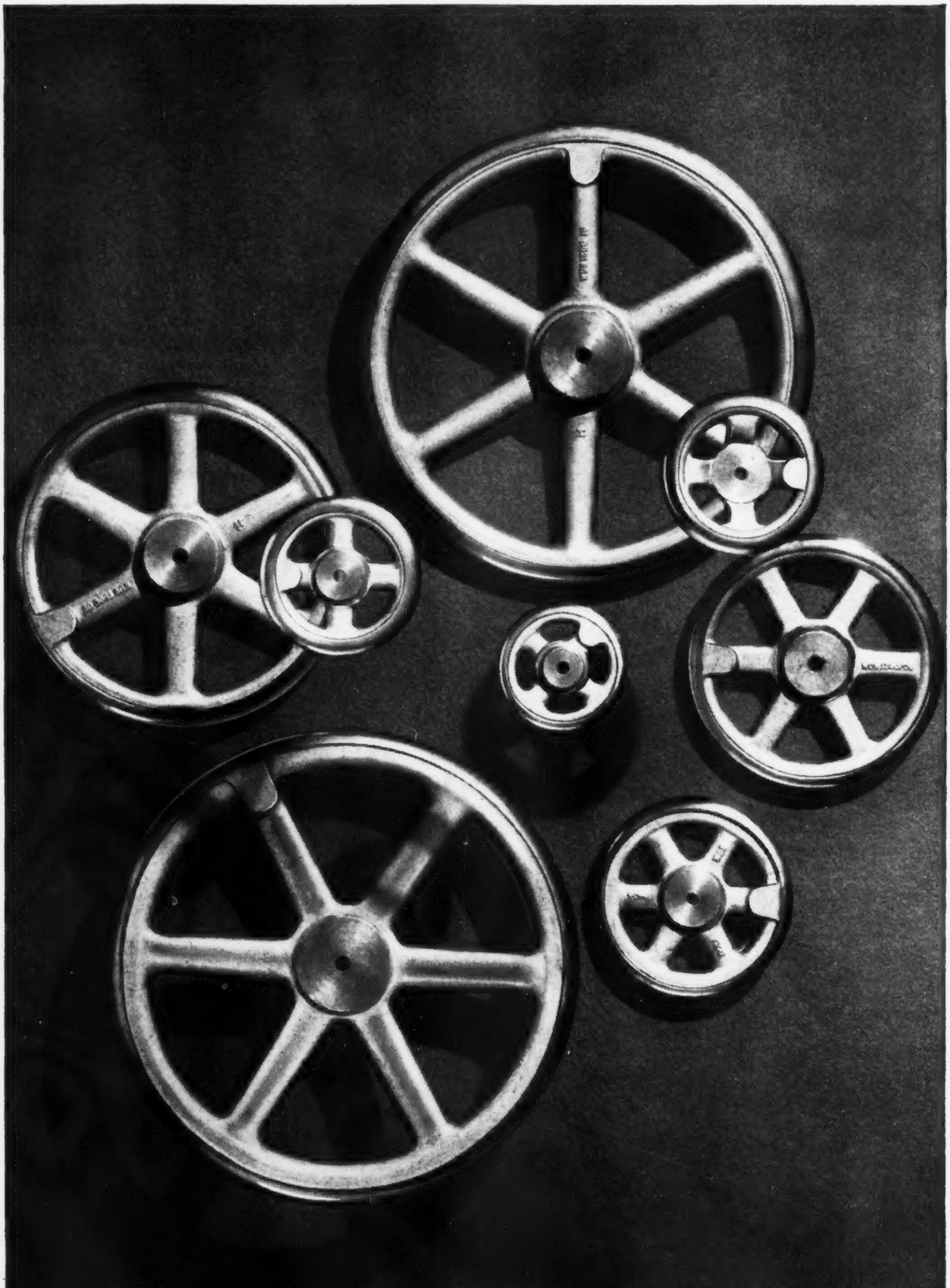
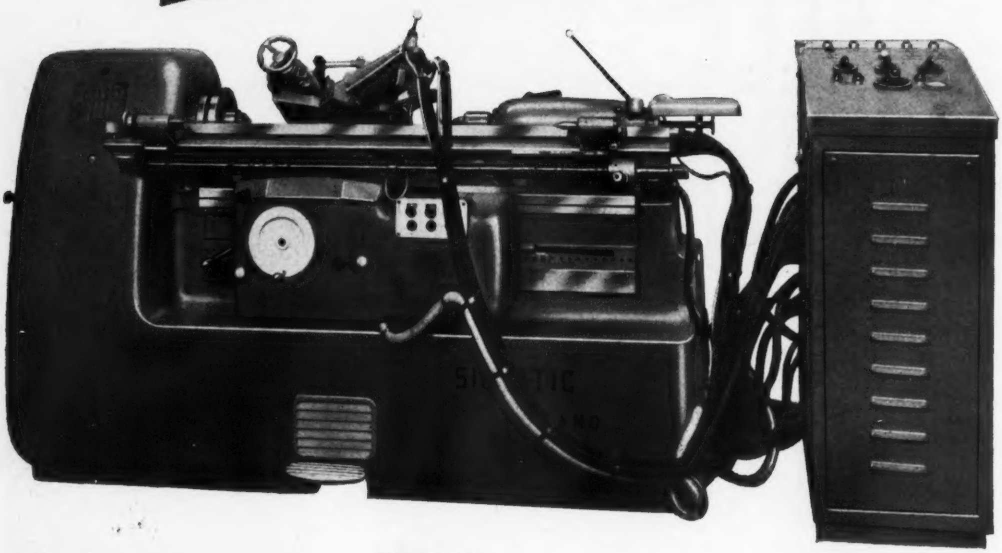


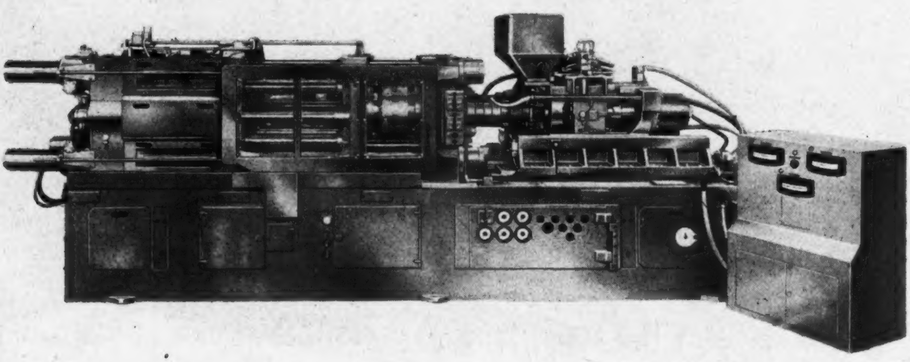



This is the NEW*
D'ANDREA
Universal Boring, Facing & Turning Attachment
* NOW AVAILABLE WITH QUICK POWER RETURN TO TOOL SLIDE!
3 sizes 8, 12 & 16in. diameter facing capacity
Why not call for a demonstration at our works
HERBERT WIDDOWSON & SONS LIMITED, Canal Street Works, Nottingham.
Tel: 51891 (3 lines)
Grams: TOOLS, NOTTINGHAM

INJECTION MOULDING AND EXTRUDER MACHINE MAKERS

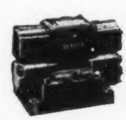
Specify

DERI SINE OIL HYDRAULIC MOTORS



Photograph by courtesy of Messrs. R. H. Windsor Ltd.

The R. H. Windsor AP30/115 Injection Moulding Machine incorporates three Deri Sine Motors to provide reliable and efficient operation.



The real test of an oil Hydraulic Motor is in heavy duty work and Deri Sine Hydraulic equipment is able to ensure reliable performance under the most gruelling continuous service on Injection Moulding and Extruding Machines. For example, where a breakdown may wreck a production schedule and cost money, manufacturers of the most modern machines take no chances—they specify Deri Sine.

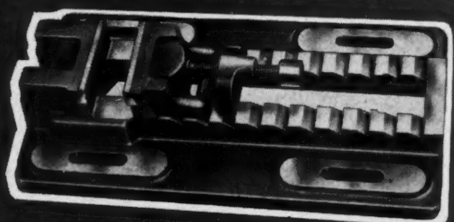
Backed by a superb range of American-designed Valves and Pumping equipment, Axial Piston and Vane type, Denison Deri can satisfy your most exacting requirements.

Denison Deri LIMITED

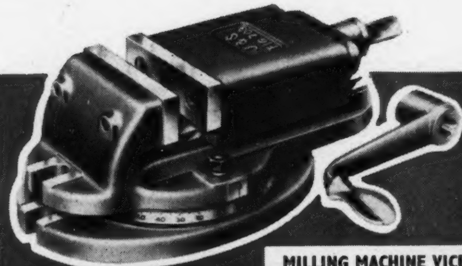
DENISON DERI LTD. · VICTORIA GARDENS · BURGESS HILL · SUSSEX. TELEPHONE: BURGESS HILL 85747/8/9


RAVENSBURG
Facing Copy Lathes
MODELS
KH 45
and 55
With the UNICOP electronic-hydraulic two co-ordinate copying system for machining deep and difficult profiles.
The headstock and carriage are mounted on a common bed with two vee-slides on which both can be traversed.
A single button on the pendant control panel sets the machine for use as a normal facing lathe without copying.
Available with infinitely variable spindle speeds and constant cutting speed control: Maximum turning diameter up to 55 inches.
SOLE BRITISH AGENTS
SYKES MACHINE TOOL COMPANY LIMITED
Hythe Works, The Hythe, Staines, Middlesex. Telephone Staines 55474 (5 lines) Telegrams Sytool Staines

J & S machine shop equipment



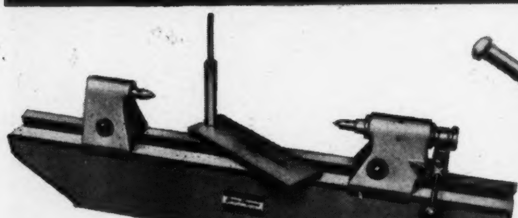
MILLING & DRILLING VICES—HEAVY DUTY



MILLING MACHINE VICES

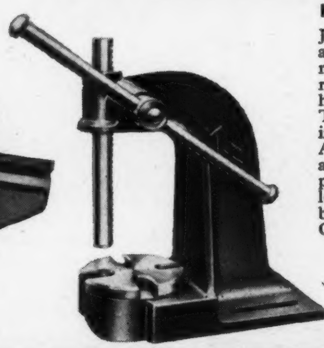
The range of J & S Machine vices covers all kinds from precision types for light grinding operations to heavy duty models for use on Milling, Drilling and Planing Machines.
The Milling Machine Vice, top right, is manufactured in two types, plain and swivel, in a variety of capacities.
An Angular Sine Vice is available for extreme precision work.

UNIVERSAL VICE FOR PRECISION GRINDING MACHINES



PRECISION BENCH CENTRES

These Bench Centres are designed to ensure maximum rigidity and perfect alignment between tailstock centres. A bracket carrying a clock indicator or any other precision tool can be provided. They are manufactured in 11 sizes from 18½in. to 72in. between centres, and 8in. to 20in. diameter swing.



MANDREL PRESSES

J & S Mandrel Presses are designed to give maximum rigidity and remain solid under very heavy pressures.
Three sizes are available in the type illustrated. A more powerful type is also manufactured which provides extra powerful leverage. All types can be supplied as Bench or Column Models.

AVAILABLE FROM ALL J & S DISTRIBUTING AGENTS

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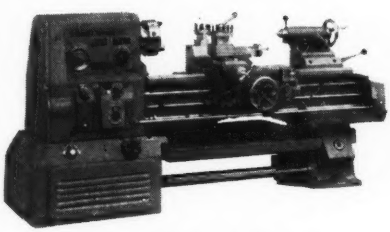
Fully Automatic Copying Lathe
— *for quick change over*

A Range of Centre Lathes

Tool room and Production Lathes with capacities up to 29in. swing over bed and 160in. between centres are available with or without copying equipment.



H.E.B. Type HN.250 Centre Lathe.

H.E.B. 'S' PILOT AUTOMATIC MULTI-CYCLING COPYING LATHE

Developed to make available fast, accurate copying methods and piloted feed features for small and medium quantity production. Special attention has therefore been paid to accessibility of setting mechanisms and speed of set up.

Whether for large or small batches, roughing and finishing, turning or boring, the 'S' Pilot can be applied to advantage. The machine has a swing over bed of $17\frac{3}{4}$in. and swing over slide $11\frac{3}{4}$in. Distance between centres is from $19\frac{5}{8}$in. to $39\frac{3}{8}$in. and maximum diameter of master $5\frac{3}{4}$in.

Write today for full details of this versatile copying lathe.

Sales and Service for the British Isles

DRUMMOND-ASQUITH LIMITED

Member of the Asquith Machine Tool Corporation

KING EDWARD HOUSE, NEW ST., BIRMINGHAM *Phone: Midland 3431.* *Also at LONDON Phone: Trafalgar 7224 & GLASGOW Phone: Central 0922*

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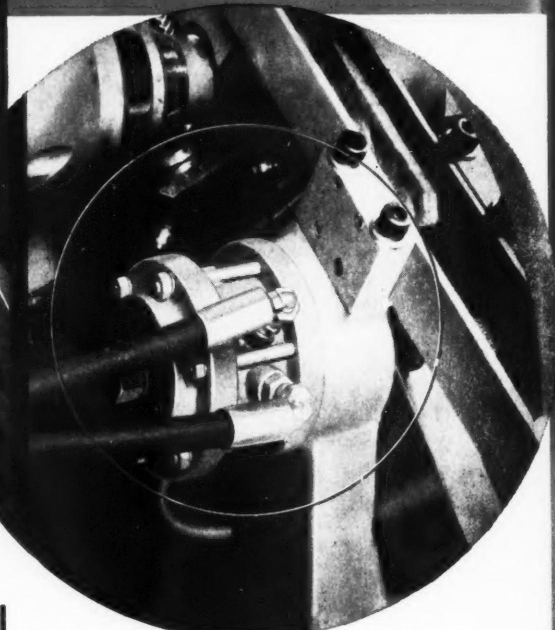

On the DAVID BROWN 'HYDRAX' GEAR HOBBING MACHINES

Lockheed semi-rotary slave units operate

1. The automatic hob shift and

2. The automatic loading—see close-up.

These Lockheed units provide a greatly simplified and compact installation.

SEMI-ROTARY SLAVE UNITS BY

Lockheed

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INDUSTRIAL HYDRAULICS

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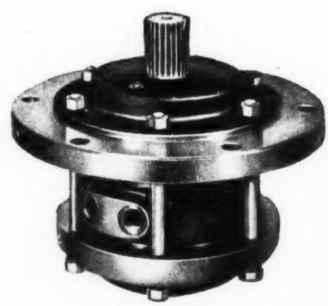
Lockheed semi-rotary units are available both in single-vane form giving up to 300° movement, and in double-vane form giving up to 120°. Torques range from 1,270 to 1,100,000 lb./ins. at 1,000 p.s.i.

Below: the flange-mounted type, also available with foot mounting.



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AUTOMOTIVE PRODUCTS GROUP

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Model 14-5
The Finest, Most Versatile, 14" Screen Contour Projector Available.
Model 14-2B
A Precision Measuring, Bench Model Projector for All-Round Use.
Model 8
Economical 8" Screen Projector. Can be used in Horizontal or Vertical Position.
EX-CELL-O
CONTOUR PROJECTORS* FIT YOUR OPTICAL GAUGING REQUIREMENTS
Model 30
A True, Heavy Duty Precision Measuring Projector with 30" Diameter Screen, and 12" Diameter Capacity
Model 14-6
with Plain Table for Production-Line Use with Chart-Gauges and Fixtures.
Model 14-6
with Measuring Table for Production-Line or Limited Tool Room Use.
Write for new edition of EX-CELL-O Contour Projector Booklet—Available Now!
SOLD AND SERVICED BY
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HALFORD HOUSE, CHARLES STREET, LEICESTER, ENGLAND.
TELEPHONE: LEICESTER 26791
TELEGRAMS: GROUPEX LEICESTER

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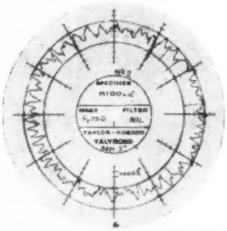
the advantages of "fine boring" techniques

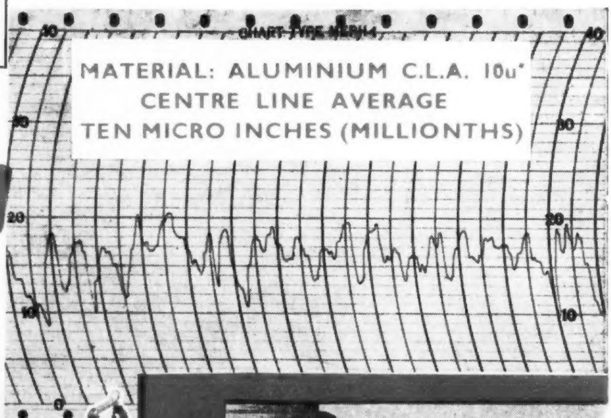
techniques are now universally accepted by progressive firms. By running the cutting tool at its maximum cutting speed, time is saved, and accuracy and finish greatly improved. Hitherto such machines were limited to light cuts and fixed centre heights: this is no longer so. The Milnes Heavy duty boring machine has overcome these limitations, and has extended the application to a wide range of general engineering components either as one offs or batches of thousands. The machine is capable of roughing castings with cuts up to ½in. deep, and spacing accurately any number of bores. It is robust, dependable and easy to operate, and can be profitably employed in all modern machine shops.

ROUNDNESS LESS THAN A TENTH

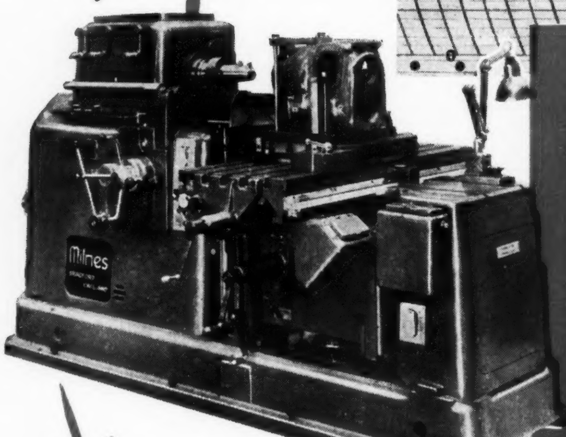
ACTUAL: 8"/100,000



THANKS TO TIMKEN **"DOUBLE ZEROS"**



ACCURACY plus FINISH



photograph by courtesy of
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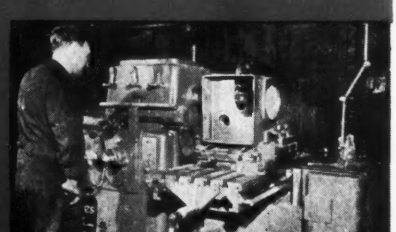

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devised and produced by

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INGLEBY WKS., ROSSE ST., BRADFORD 8, YORKS.

TELEPHONE: BRADFORD 41301

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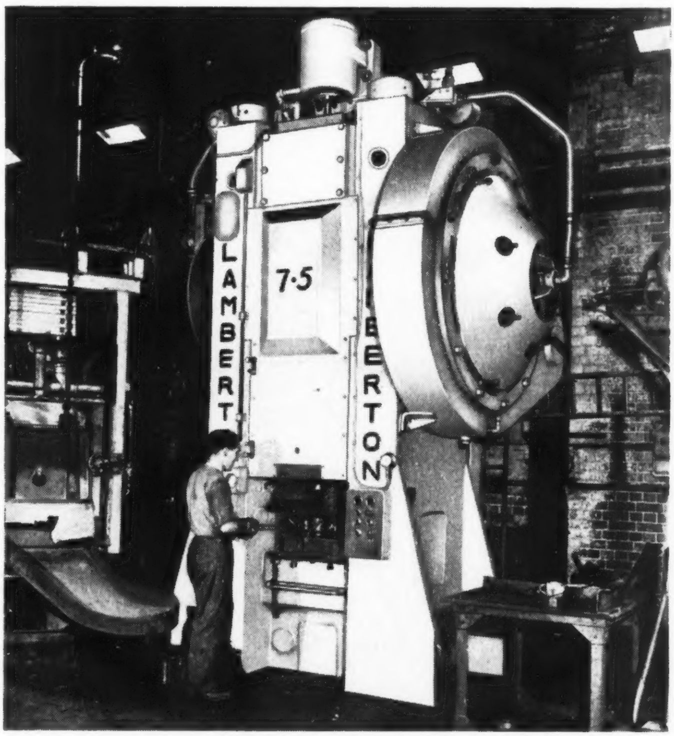
LAMBERTON

750 TON VERTICAL FORGING PRESS



Photograph by courtesy of The Austin Motor Company Limited

A fast working press suitable for mass production forging
An automatic feeder can be fitted

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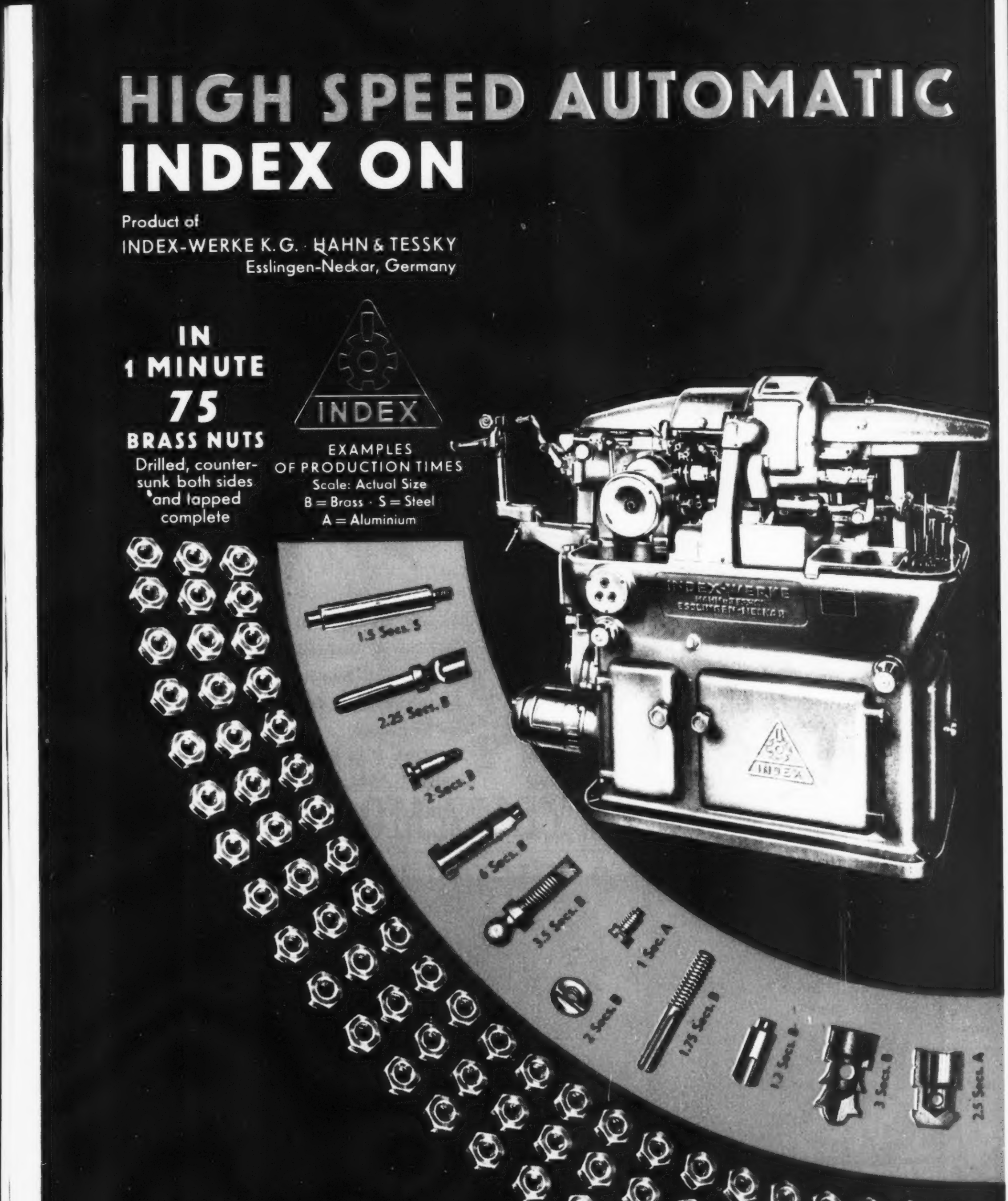
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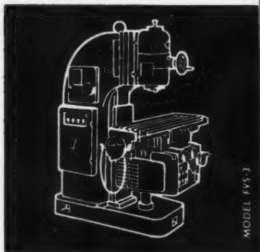

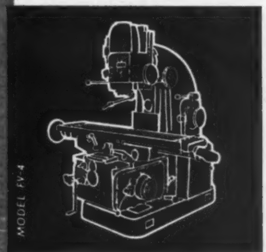

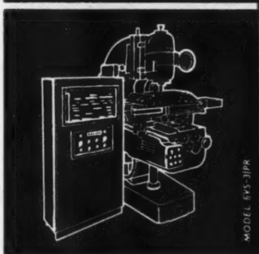

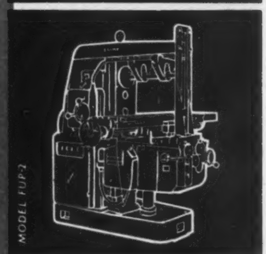

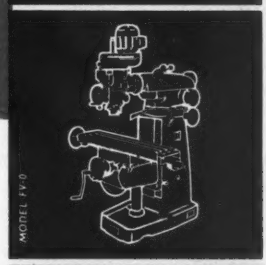

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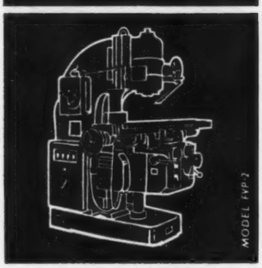

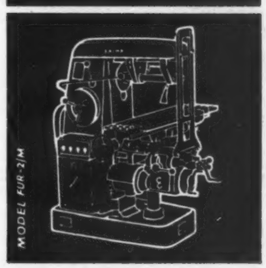

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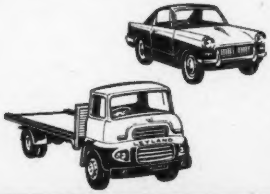

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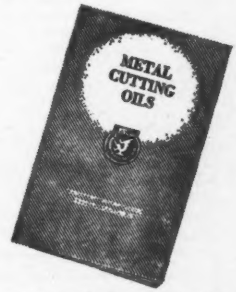

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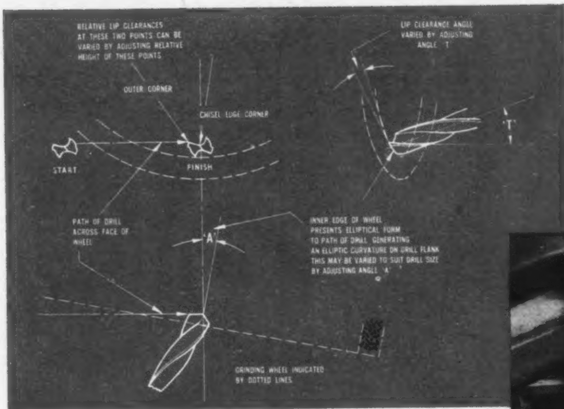

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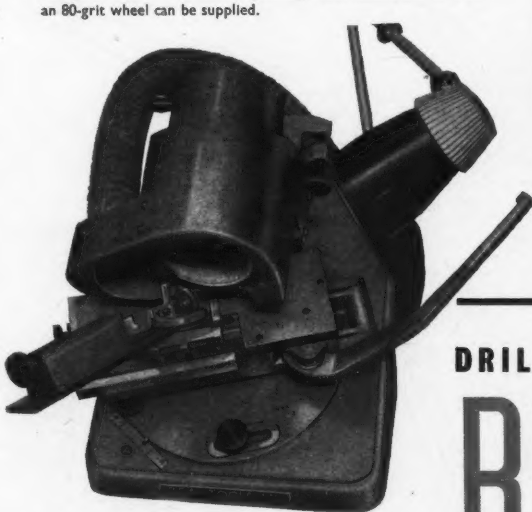

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MEMBER OF THE AUDIT BUREAU OF CIRCULATIONS	COPIES PRINTED	11,500 per week
	CERTIFIED DISTRIBUTION	11,293 per week
	CERTIFIED PAID DISTRIBUTION	9,827 per week
	Copies sold at full price	9,594 per week
	Copies sold at reduced prices	233 per week

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Abstracts of Principal Articles

WERRA Camera Production .. P. 1352

This fourth article on the activities of the East German firm of VEB Carl Zeiss, Jena, is concerned with the production of the WERRA range of 35-mm. cameras at their Eisfeld works. After briefly describing the range of cameras, some details are given of the factory, which provides employment for about 500 people and has a floor area of some 50,000 sq. ft. Operations carried out on the pressure die cast aluminium camera body, supplied from the South Works in Jena, include turning, boring and facing of the lens-mounting surfaces on a Zeiss RB 34 instrument lathe. The film plane surfaces are then semi-finish milled, and several mounting boss faces on top of the casting are also milled. Drilling, reaming and tapping operations are carried out on a line of bench drills, with the operator seated on a wheeled stool for ease of movement. Diamond-turning operations performed on camera parts are designed to provide decorative bright surfaces, and special lathes are provided. Special machines are also used for engraving symbols on lens and other adjustment rings, five at a time. During final assembly, milling of the film plane surfaces to ensure accurate positioning relative to the lens-mounting face, is performed on two machines, on one of which a diamond tool is employed. (MACHINERY, 99—13/12/61.)

Some Applications of Fractured-race Ball Bearings .. .. P. 1361

Fractured-race ball bearings offer two main advantages, namely that they can be arranged to incorporate more balls than can be carried by a conventional bearing—and consequently their load carrying capacity is increased—and, as the result of the increased number of balls, the life of such a bearing is extended. The design of bearings made by Split Ball Bearing, Lebanon, N.H., U.S.A., is discussed, also applications in connection with light power tools and transmissions for motor vehicles. (MACHINERY, 99—13/12/61.)

The Butler Machine Tool Co., Ltd., Mile Thorn, Halifax .. .. .. P. 1365

Founded by James Butler in 1868, the Butler Machine Tool Co., Ltd., have specialized in the building of planers, shapers and slotters since 1917, when the first part of the Mile Thorn works was built. The works have been extended at various times, the latest addition being the new machine shop, completed in 1950. A new drawing office was built on to the adjacent office block in 1959. The works are on a site of 5½ acres, and are sub-divided into departments, which specialize in the building of different types of machines, on a batch production basis. Extensive use is made of unit construction, and the illustrations accompanying this article show some typical machining and assembly operations in connection with building machines in the company's range. (MACHINERY, 99—13/12/61.)

The Rodolite .. .. P. 1377

Known as the Rodolite—a name derived from the expression "rod of light"—the system here described employs circular diffraction gratings and enables inspection of the main elements and movements of machine tools to be made to a high accuracy. The application of the instrument is described in connection with checking the table and hobbing slide of a large gear hobbing machine. (MACHINERY, 99—13/12/61.)

Making the New Borg-Warner Automatic Transmission .. .. P. 1392

A previous article was concerned with the machining of pressure die cast aluminium alloy castings employed in the hydraulic control valve assembly for the new Borg-Warner automatic transmission, and further operations on these castings are here considered. Side faces on castings of two sizes are finished by grinding at a single set-up with a wide-faced wheel. The joint faces are then finished on a wheel-type flat honing machine on which the castings are held in a carrier plate and simultaneously oscillated and rotated. Some other operations on the smaller casting, including face milling and drilling and tapping, are also described. (MACHINERY, 99—13/12/61.)

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Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

EDITORIAL

Matched Machining or Selective Assembly ?

Although machine tools are now available which enable very close tolerances to be maintained on both internal and external work diameters in quantity production, where exceptionally fine limits are specified for the fits or clearances between mating components it is sometimes expedient to forego the advantages of interchangeability. In this connection it may be noted that even if limits as fine as ±0·0001 in. are held on each of two components, the amount of clearance or interference on assembly may vary by as much as 0·0004 in., which may be unacceptable.

To overcome the problems associated with the attainment of very exacting fits, two methods can be employed, either of which may yield very satisfactory results in certain circumstances, namely matched machining and selective assembly. In principle the former method is as old as engineering, and dates back to the time when the skilled lathe operator machined a shaft to suit a previously finished bore, aided only by calipers. This technique has since been greatly refined, and on certain machines it is now possible to grind an external surface to match a bore to a remarkable degree of accuracy, on a quantity basis and under automatic control. For this purpose, it may be recalled, the mating component is placed on a gauging mandrel adjacent to the machine, and while grinding is in progress the diameter of the male part is continuously compared with that of the bore, and the operation is automatically terminated when the required relationship has been obtained.

An example described recently in MACHINERY affords an indication of what can be achieved by this procedure under production conditions. In this particular instance, a 19-mm. diameter part is ground to suit the bore of a sleeve, and it is specified that the clearance between the assembled parts must not vary by more than 0·00004 in. To maintain this relationship combined with interchangeability, it may be noted, it would be necessary to hold limits of ±0·00001 in. on both parts.

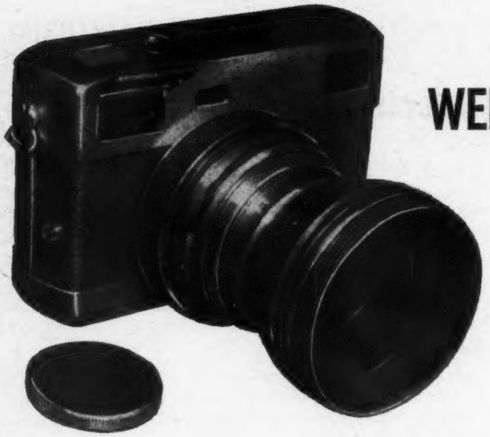
Selective assembly is, of course, based on the principle that if a large number of parts is produced within a tolerance band that can be maintained without undue difficulty, the choice of size afforded will permit selection to achieve almost any desired refinement of fit with a particular mating component. If it is necessary to rely on manual gauging the task may be very tedious and may demand a considerable degree of skill, but with modern gauging equipment it is possible to segregate components into a number of size grades, in each of which the diameters vary by only a very small amount. With the mating parts correspondingly classified, assembly can then be carried out almost as easily as it would be if all the parts were interchangeable.

One effective application of selective assembly is concerned with the plungers for fuel injection pumps which, as is well known, must be a very close fit in the bores. To achieve the required results, one manufacturer segregates plungers of any particular nominal size into 20 grades, each covering a diameter range of only 0·00002 in. Obviously, highly developed equipment is necessary to enable parts to be separated automatically with this degree of discrimination. At the same time it will be evident that it is considerably easier to arrange for such segregation than to attempt to produce parts to the grade tolerance.

Attention was drawn to other accomplishments in the field of automatic gauging for selective assembly in a paper presented by Mr. A. W. Wiseman to the American Society of Automotive Engineers. One gauging machine described, enables gudgeon pins to be inspected at the rate of 3,750 per hour. These pins are rotated at the gauging station, and are checked for roundness and taper as well as for size. The tolerance on diameter is 0·0003 in., and gudgeon pins which are accepted are simultaneously classified in steps of 0·0001 in., a memory system being incorporated to ensure that they are subsequently separated into the three classes when discharged.

For the corresponding piston the problem is complicated by the fact that it must be checked and identified for selective assembly both with a gudgeon pin and a cylinder bore. The machine employed handles 1,500 pistons per hour, and at the first station both ends of the gudgeon pin bore are inspected by means of pneumatic gauges for size, roundness, and taper. Again, there are three size steps, each of 0·0001 in., and the size classification of each accepted piston is automatically stamped on the head. Subsequently the pistons are checked for skirt diameter, skirt taper, and ovality, and for this diameter there are 10 size grades, in steps of 0·00025 in. Each accepted

(*Continued on page* 1410)



WERRA Camera Production

Methods Employed by VEB Carl Zeiss, Jena, at the Eisfeld Plant, Thuringia, East Germany

By R. E. GREEN, Associate Editor

ONE OF THE ACTIVITIES to which the East German firm of VEB Carl Zeiss, Jena, has turned during recent years, on instructions from the Government, which decided that all manufacturing companies should produce consumer goods of some kind, is the production of cameras. This development was mentioned in the first of this series of articles*, and some details of the type of camera which was designed, and of the methods employed in its production, are given here.

THE WERRA RANGE OF CAMERAS

Named after the river Werra, a tributary of the Weber flowing through Thuringia, the camera takes 35-mm. standard motion picture film, and the original design was such that a total of six variations could be made, all incorporating many common components. In its simplest form, the camera has a non-interchangeable Tessar f/2·8, 50-mm., lens with a front-mounted shutter and simple view-finder, and is known as the WERRA 1. The shutter is wound by partial rotation of a collar surrounding the lens mount, and a lens hood is provided, with a multi-start thread which screws into this collar, to afford protection when the camera is not in use.

There is also a Werra 2, which is similar but incorporates a built-in exposure meter bought out from VEB Feingeratewerk Weimar. The Werra 3 has no exposure meter, but is arranged to take interchangeable lenses and is fitted with a wide-base coupled range-finder, and in the Werra 4 all the features so far enumerated are included. The latest version of the camera, the Werramat, is similar to that shown in the heading illustration, and has a built-in mechanism whereby the action of adjusting the exposure meter to the prevailing light conditions automatically sets the lens diaphragm and shutter to the values required for those conditions.

The most elaborate design is known as the Werramatic and resembles the Werramat, with the addition of the coupled range-finder from the Werra 3 and 4 cameras. With the Werramat and the Werramatic cameras, two small mirrors, set in the view-finder window, reflect images of the settings of the diaphragm and shutter into the eye-piece at one side. In addition, the indicator pointer of the exposure meter is read while looking through the view-finder, so that all the essential information for setting the controls to suit the lighting and the distance of the object to be photographed is readily available without taking the camera away from the eye.

Since the complete series of Werra cameras was planned before production began in 1953, it was possible to arrange for the use of many standard parts, of which there are 227 in all, out of the 1,086 components required for the full series. As a result of careful design of individual components, and the provision of multi-purpose tooling, jigs and fixtures for only 336 individual parts are required for the production of the entire range of cameras. Of the camera components, some 39 per cent are made by turning or milling operations, and a further 20·5 per cent by press shop methods. Of the remainder, 24 per cent require combina-

* MACHINERY, 99/652—20/9/61, 99/842—11/10/61 and 99/1296—6/12/61.

tions of stamping and machining operations, 8 per cent are of plastics or rubber parts, 5 per cent are optical parts, and 3·5 per cent are pressure die castings.

These castings, which include the body, back, range-finder base-plate, lens carrier, and film stage, are produced in the die casting foundry at the South Works, mentioned in the second article of the series. Plastics and rubber parts are supplied from the main works at Jena, and lenses and other optical parts from the Saalfeld plant, but most of the machining operations, and the assembly of the cameras, are carried out at a small factory in the town of Eisfeld, about 50 miles from Jena, near the border with West Germany.

THE EISFELD CAMERA WORKS

Originally built in 1923 as a toy factory, the building in which Werra cameras are produced was used as a school after 1933 and subsequently as a factory for the manufacture of aircraft instruments. In 1945, the factory was dismantled—as were many others—by the Russians, and the building stood empty until 1952, when Zeiss began to use it as a tool-making and small machine shop. The manufacture of Werra cameras began there in 1953, and production has increased year by year and reached a total of 50,000 in 1960. Mainly of wood construction, for which material is readily available in the district, the factory has a floor area of about 50,000 sq. ft., and a productive area of 42,400 sq. ft., on two floors, and is at present being extended.

In addition to cameras, the factory produces 35-mm. slide projectors of 100- and 375-watt capacity, sub-assemblies for 35-mm. sound-film projectors, and toy diesel engines for model ships and aircraft. Some 500 people are employed in the works, including a small number who attend a vocational training centre to learn instrument-making, and of the total, about 200 are women. The factory is operated on a single shift and 45-hour week, except for the machine shop and surface-finishing department, which have limited capacity and are run on a double-shift basis. Wage scales are basically similar to those quoted in the first article of the series. As the employees come from a rural area, they are characteristically diligent, and it is stated that their outputs are slightly higher than those maintained by workers in other Zeiss establishments. The proportion of administrative staff appears to be higher than in this country, and this applies throughout the organization. Some 45 people are employed solely on inspection and testing of components, sub-assemblies and complete cameras. Design of cameras is carried out at Jena, and there are only a few qualified engineers at Eisfeld, who are concerned with the design of tooling and method studies.

MACHINING OF CAMERA BODIES

Bodies for all the cameras in the Werra range are machined from a common pressure die casting of Silumin aluminium alloy containing up to 13 per cent of silicon. The first operation on such a casting, which is received in the fettled condition, is carried out on the Zeiss RB 34 instrument lathe shown in Fig. 1. Details of the design of this lathe were given in the second of the articles previously published, and this particular machine is

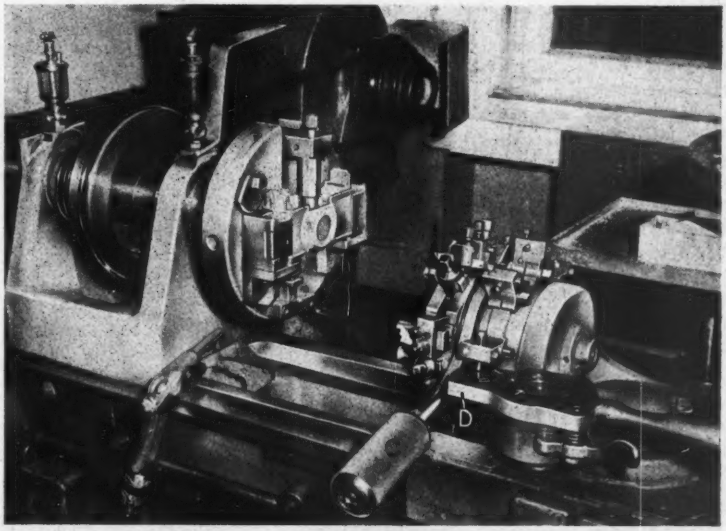


Fig. 1. Turning, boring and facing operations on Werra camera bodies are carried out on this Zeiss RB 34 instrument lathe, on which the casting is held in a face-plate type fixture

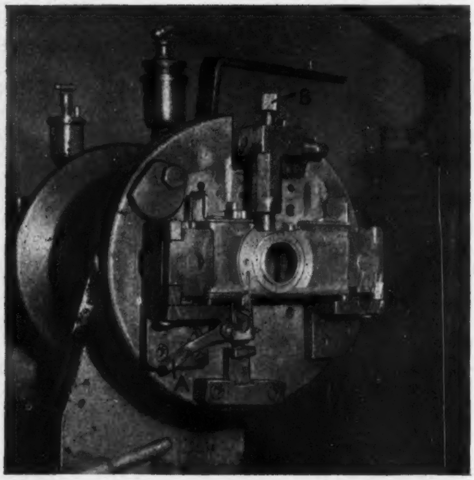


Fig. 2. Close-up view of the face-plate fixture on the machine in Fig. 1, showing details of the locations and clamping mechanisms

fitted with a face-plate fixture to hold the work, as seen in the close-up view, Fig. 2.

From this close-up view it will be seen that the casting is loaded with the front face outwards, and it is located by the rear side faces and supported in brackets at each end. For endwise location, a spring-loaded plunger enters a cast slot in one face and can be retracted, for loading and unloading, by means of a lever *A*. Two swinging clamps which are pivoted to the supporting brackets, and connected to the air-operated draw-bar of the machine spindle, are applied to the ends of the casting.

On the side opposite the locating plunger, the casting is steadied by a screw with a knurled head *B*, in a swinging lever which is pivoted in a slot in the face-plate. This lever is lowered, and secured in position by a sliding pin at the right, before the screw is turned to bring the end into contact with the casting. A spindle speed of 1,200 r.p.m. is employed, and the operations are performed manually. Tools in the turret are moved by means of the handle *C*, Fig. 1, for facing cuts, the travels being limited by stops on the drum which come into contact with the retractable abutment *D*. Turning and boring operations are carried out by traversing the turret saddle with the required tool in position and the corresponding stop held against the abutment *D*.

One internal and two external diameters are machined at this operation, also three faces, the largest of these faces being employed for location of the casting at later stages.

Next, the contact faces of the film gate are semi-finish milled on the simple vertical machine shown in Fig. 3, built by the small private firm of Bernhard Paatz, in nearby Zella Mehlis. In the fixture provided, the casting is positioned by the central bore in the front wall, which is engaged with a circular projection, angular location being taken from one long side which is held in contact with an abutment. At the centre of the circular projection there is a vertical draw-bar which can be raised and lowered by movement of the cranked lever *E*, and a

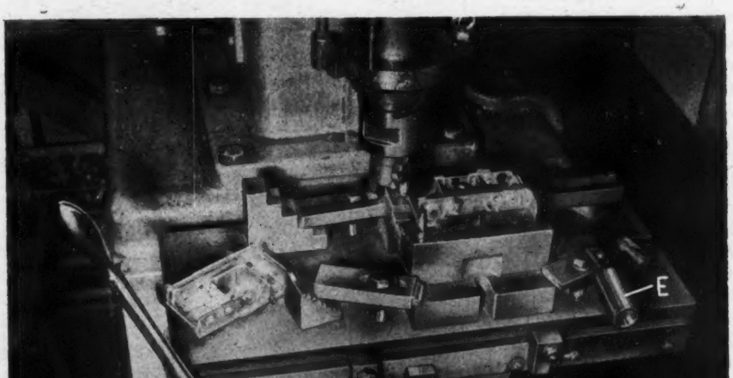


Fig. 3. Machining of the surface of the film gate at the rear of the camera body is performed with a two-tool cutter on this Paatz vertical milling machine

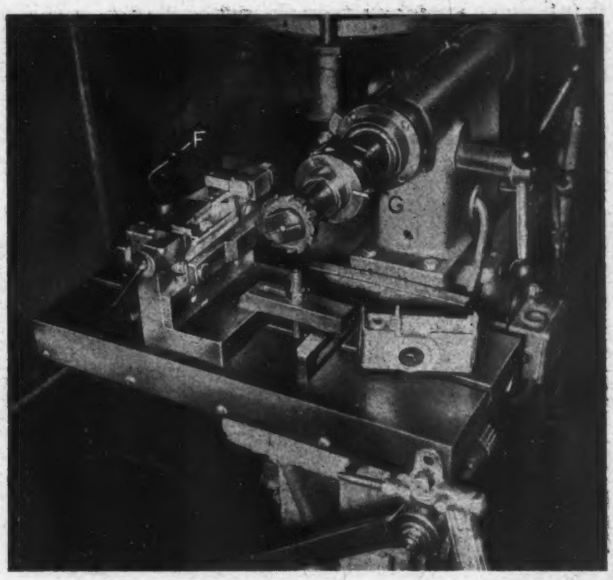


Fig. 4. The surfaces of four bosses on top of the camera casting are machined flat with a combination of conventional and special milling cutters on this Paatz machine, which employs a spindle housing similar to that on the machine in Fig. 3

slotted washer is inserted beneath a nut on the bar before the latter is pulled down to clamp the casting.

The spindle of the machine is driven at 3,000 r.p.m., and is fitted with a head in which two cutters are mounted at a radius of 1 in. Manual feed is applied to the machine table by the lever at the left, through rack and pinion. An allowance is left on the surfaces milled, which are eventually finished in one plane within 0·01 mm. (0·0004 in.). Additional operations are performed on the small horizontal milling machine shown in Fig. 4, which has a spindle housing of similar design to that on the previous machine, but arranged horizontally, and a similar table. In the fixture, the casting is held in a nest and is located by a register which engages the bore in the front face.

For clamping, there is a horizontal bar carried on two plungers, which are connected by a second bar on the far side of the fixture wall. Force is applied to this bar by a cam when a lever *F* is moved to turn a vertical shaft. Subsequently, screw-operated pads, at the ends of the fixture, are applied to the arcuate projections at both extremities of the camera body in order to provide additional clamping. The milling spindle, which, again, is driven at 3,000 r.p.m., carries a plain cutter at the extreme end to machine a range-finder mounting boss. Another boss for the range-finder is machined by a fly-cutter in a reduced-diameter portion of the body *G*.

The main portion of the body *G* carries three cutter blades which machine an annular mounting boss for the exposure meter mechan-

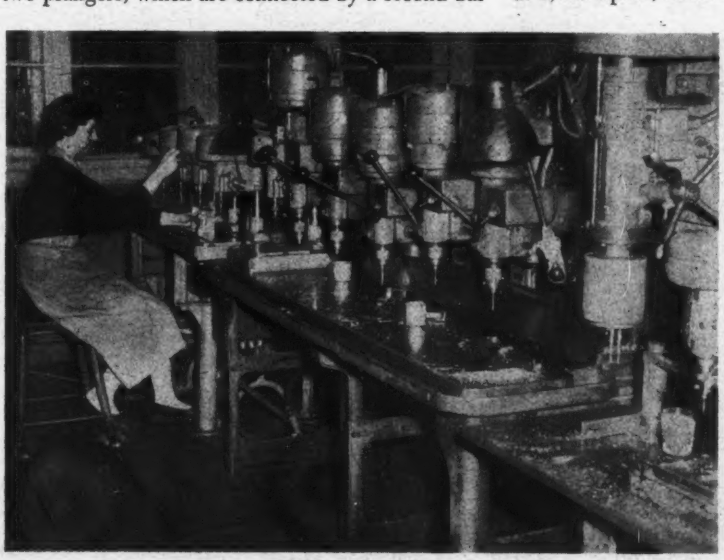


Fig. 5. The stool on which the operator sits is arranged to move on grooved rollers along rails set in the floor to enable drilling and other operations to be completed without rising

Fig. 6 Some of the machines in the line in Fig. 5 are equipped with multi-spindle heads. A simple box jig holds the casting and is roughly located beneath the spindles by angle fences

ism, and in a third portion on the far side, there is another single cutter for machining a fourth boss near the end of the casting. Manual feed is applied to the table by means of the lever in the lower foreground.

Drilling, reaming and tapping operations are next carried out on a line of bench drills as seen in Fig. 5, the operator being provided with a stool which is supported on a steel framework. The framework has a grooved roller at each corner, and the rollers run on rails of semi-circular section, set in the floor. With this arrangement, the operator can move freely from one machine to the next to perform the required sequence of operations, without rising. According to the design of the particular camera for which the batch of castings is intended, the number of holes on which operations are performed varies from 21 to 30, and they are in five sides of the casting.

Box-type drilling jigs are employed, and simple angle-fences are provided at each drilling machine—several of which have only a single spindle—to locate the jig approximately in the required position. One of the jigs employed is seen in Fig. 6, opened to show the method of loading. After placing the casting in the box and engaging the central bore in the front face with

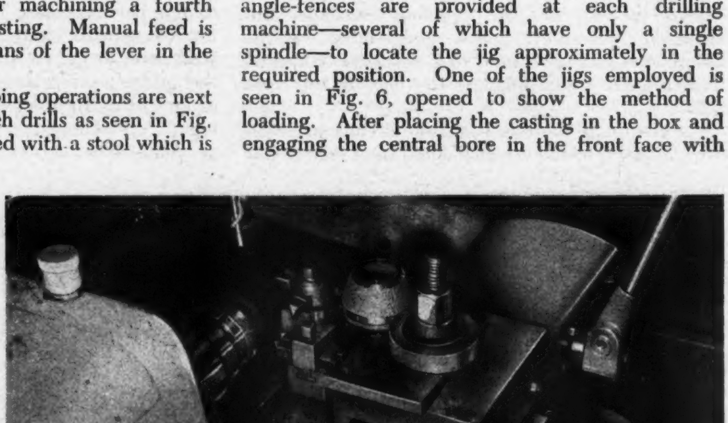


Fig. 7. Diamond-turning, to produce a bright polished surface on certain camera components, such as the lens hood, is carried out on a lathe fitted with special bearings, to permit a speed of 2,800 r.p.m.

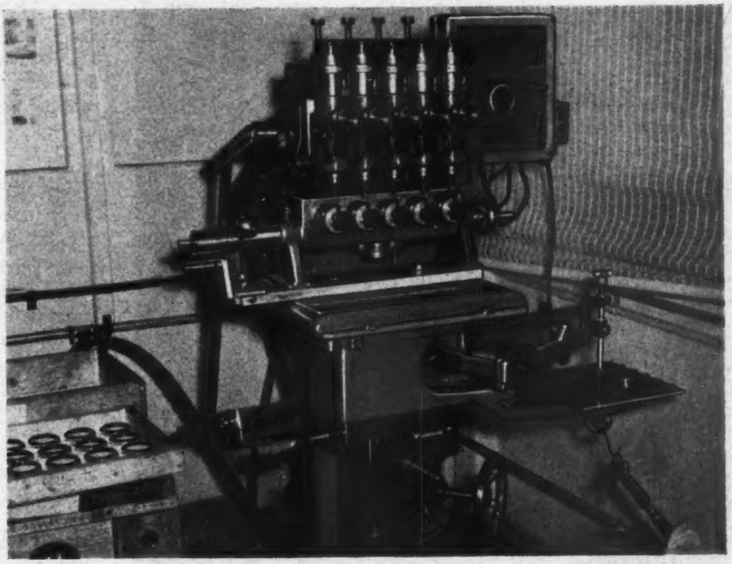


Fig. 8. Special Zeiss-built machine for engraving lens mounts and setting rings

the register, the lid, which has an elongated hole for the hinge pin at one end, is swung over and a reduced portion at the other end is engaged in a slot in the opposite wall. Pressure is then applied to the previously milled film gate surfaces, by a captive plate of suitable shape, which is thrust down by a cam.

Each of the machines is fitted with electric micro-switches whereby the spindle-driving motor is automatically started as the quill is lowered, and switched off when it is raised. Some of the drilling machines, as seen in Fig. 6, are fitted with multi-spindle adapters, and in addition to drills, taps and reamers, the tools may include spot-facing cutters. With all the initial machining operations completed, the bodies are passed to the surface treatment department where they are covered externally with a black plastics, wear-resistant coating, which is cured in an autoclave at a temperature of 140 deg. C.

Other surface treatment applied to the bodies includes anodizing of the internal surfaces, which are subsequently dyed black. The castings are then returned to the machine shop, and the range-finder mounting faces are finish-machined, also two edges on the ends are milled for decorative purposes. Other light alloy components which are handled on conventional machine tools with simple set-ups, are subjected to similar treatment. Certain surfaces on the cover surrounding the lens mount, known as the cocking ring, and on the lens-setting rings, the lens hood, the exposure counting ring, the re-winding mechanism and the tripod nut are precision turned with diamond tools to produce bright surfaces.

After diamond-turning, the surfaces are coated with transparent hard varnish to prevent deterioration of the finish. Diamond turning is carried out on lathes provided with special spindle bearings, an example being shown in Fig. 7, set up for operations on lens hoods. On this machine, the spindle runs at 2,800 r.p.m., and the turret carries three tools, one of which is diamond-tipped and is employed to turn the diameter adjacent to the multi-start thread at the larger end. The component is held on an expanding mandrel and the feed movements are applied by hand levers.

In addition to the Zeiss RB 34 instrument lathe, which is widely used in the factory, there is an automatics shop equipped with single-spindle machines by Skoda (Selson Machine Tool Co., Ltd.), MAS (Elgar Machine Tool Co., Ltd.), and Index [Geo. Kingsbury & Co. (Machine Tools), Ltd.]. Swiss-type automatics built by Ruhla (William Watts, Ltd.), and Strohm (Adam Machine Equipment, Ltd.) are also installed. An interesting method is employed in the production of face-type gears for the drive between the film speed setting lever and the exposure meter mechanism on certain cameras. The gear teeth are produced on the face of the bar by a cold-forming operation before the remainder of the machining is completed. There is a small press shop for such parts as the top cover, which is produced from brass sheet, and other operations carried out in this shop include the shaving of the film gate aperture in the body casting, on a hydraulic press.

ENGRAVING OF SETTING RINGS

Cameras such as that shown in the heading illustration, also the less complicated types, require a variety of engraved rings showing the

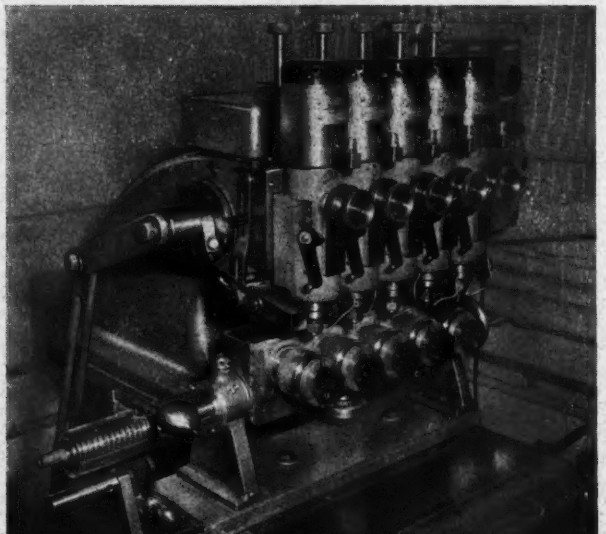


Fig. 9. Close-up view of the work-table and spindle head of the machine in Fig. 8, showing details of the individually-motorized spindles and the indexing mechanism for the workpieces

values of the shutter speed and diaphragm opening, and depth of focus, for example. For the production of such rings in the required numbers, special machines have been designed and built, one of which is seen in Fig. 8. Designed for the engraving of symbols on five rings at a time, the machine has a vertically-moving slide, carrying five separate, self-contained engraving spindles. These spindles are driven at a speed of 9,000 r.p.m. by integral fractional horse-power motors, which are supplied from a frequency-changing unit at the rear of the machine.

A close-up view of the spindles is given in Fig. 9, and each is fitted with a collet chuck to hold the engraving tool. Provision is made for both coarse and fine vertical adjustment of the individual spindles, and any spindle can be raised and held in the retracted position, by a lever on the outside of the housing, when it is not in use. A lever at the left, actuated through a linkage from the operator's position, enables the slide carrying the spindles to be lowered and raised at the start and finish of an engraving sequence.

The table beneath the spindles can move longitudinally and transversely on ball slide-ways, and it is connected through a pantograph linkage to a stylus-holder, seen at the right in Fig. 8. A bracket on the bed holds a grooved table on which the patterns for the symbols to be engraved are supported, and the pantograph is arranged to provide a reduction between the stylus and the table movements of 8 to 1. The

Fig. 10. Finish-machining of the lens plane surfaces at the back of the camera is carried out with a diamond-tipped fly-cutting tool, running at 12,000 r.p.m., on this special machine

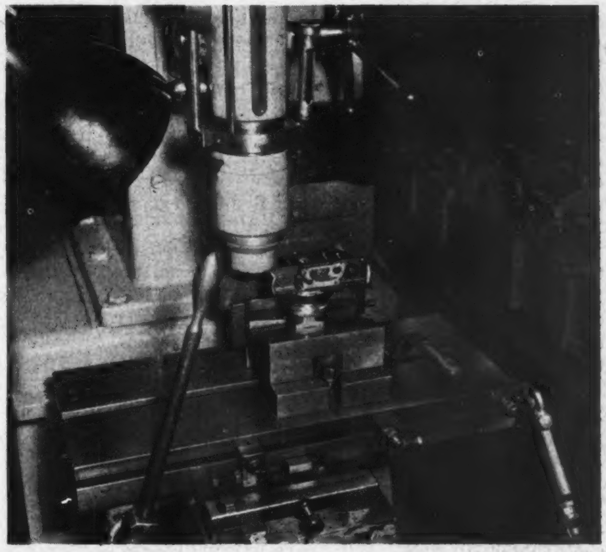


Fig. 11. A similar operation to that seen in progress in Fig. 10 is performed on those cameras to which interchangeable lenses are to be fitted. The cutter of this machine runs at 3,000 r.p.m.

table carries the indexing work-holder, seen in Fig. 9, which has five parallel shafts to carry the workpieces. For angular location in the final assembly, each of these ring-type components has a slot, and this slot is engaged with a pin on the shaft of the engraving machine.

A C-washer and nut are employed to hold each piece in place on the shaft, and the table can be adjusted by means of compound slides to bring the work to the required position relative to the points of the engraving cutters. Each of the shafts of the work-holder is connected by a worm-drive to a longitudinal shaft extending for the length of the unit. The right-hand end of this shaft carries a hand-wheel for adjustment of the angular positions of the workpieces, and at the left-hand end is keyed an axially-sliding bush with a worm thread, which is protected by a cover of transparent plastics material.

At the left in Fig. 9 can be seen a horizontal ball-end lever, which is supported from a bracket and is urged downwards by a spring. On the underside of the lever there is a V-shaped projection, which enters notches of similar form in the crest of the worm thread, to hold the shaft in angular positions corresponding to those at which characters are to be engraved in the workpieces. This arrangement enables larger locating grooves to be employed, for characters which are closely spaced, than would otherwise be possible, the threaded bush being displaced axially, as required, to bring different portions of the thread crest beneath the lever.

SLOW-MOVING CONVEYOR LINE FOR ASSEMBLY OPERATIONS

Assembly of the Werra camera is carried out almost entirely by women who are specially trained for the work. As far as possible, components are made up into sub-assemblies which can then be stored until they are required for a particular type of camera. Examples of such sub-assemblies include the range-finder and view-finder units, the film drive, including the transport roller, and the exposure meter mechanism. Inspection of each unit and any necessary adjustments are carried out at the appropriate stages.

Line methods have been adopted for the final assembly, with slow-moving conveyor belts passing the bench positions at which the individual operations are performed. Camera backs and bodies are fed on to this belt in containers which hold five of each, and the sub-assemblies are built into them in stages. At one stage, a facing operation is performed, at which the distance from the lens flange to the surfaces over which the film runs (the focal plane), is held to limits of $\pm 0{\cdot}0004$ in., and the Zeiss-built machine for carrying out this operation on the Werra 1 and 2 cameras is seen in Fig. 10.

This small machine incorporates an engraving-spindle motor similar to those employed on the machine in Fig. 8 and 9, which is run at 12,000 r.p.m. The casting is positioned from the lens-mounting flange, which was machined earlier, and is held in place in the simple block-fixture by means of a lever-operated draw-bar passing through the lens aperture. It is traversed past the diamond-tipped single-point tool in the spindle by means of the lever held in the operator's right hand, the rear end of which is pivoted on the machine base.

Another machine, employed for the corresponding operation on the more complicated variations of the basic camera, is shown in Fig. 11, and is

similar to that in Fig. 3. Cameras faced on this machine are of the interchangeable lens type, and each body is fitted with an adapter having an internal face against which a locating face on the lens mounting is pressed when the lens is installed. The fixture provides for supporting the partly-assembled camera by this internal face, and it is clamped in position by a lever-operated draw-bar, as before. The spindle is driven at 3,000 r.p.m., and has a single carbide-tipped fly-cutter.

In addition to visual checks, and operation of the shutter and film winding mechanisms at the end of the assembly track, each shutter speed is checked individually. Prestor shutters of the rotary blade type, made by VEB Kamera & Kinowerke, Dresden, are employed, and have speeds to 1/750 sec. Inspection and adjustment of the coupled range-finders, on those cameras to which they are fitted are also carried out, before the finished cameras are passed to the packing and despatch departments.

METALPHOTO NAME AND INSTRUCTION PLATES. Aluminium nameplates and instruction plates can be rapidly produced by the use of the Vari-Typer Headliner type composing machine in conjunction with the Metalphoto nameplate process which has been introduced by R. H. Lighting, Ltd., Cobham, Surrey. The Vari-Typer Headliner machine provides for photographic composition, with automatic development, in a wide range of type styles on either film or paper, the latter being used where lithographic equipment is available. Alternatively, the film positive itself can be used to make a reverse plate, or contact positives. Enlargement or reduction of type can readily be obtained with accuracy and sharpness.

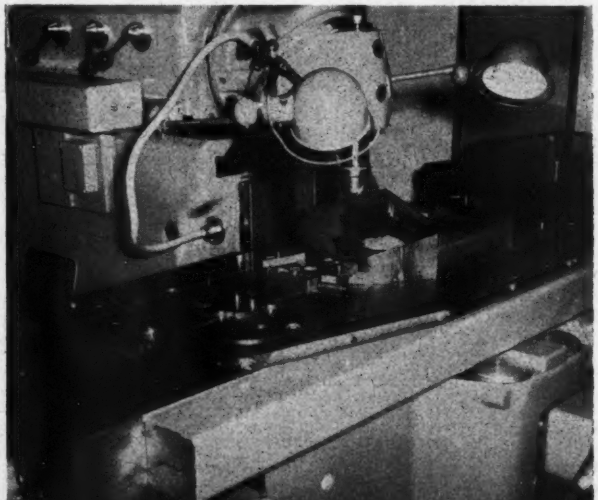
The Metalphoto plates, of aluminium, are available in a wide range of sizes and thicknesses, and the material has a hard anodized layer with photo-sensitive properties. A lithographic negative bearing the necessary information is placed in contact with the Metalphoto plate, which is exposed, developed, fixed, and washed in the same manner as a photographic print. The processing can be carried out under usual dark-room safe-light conditions, and to seal the image permanently in the anodized layer, the plate is boiled in water for 30 min.

Huron/Ferranti Tape-controlled Milling Machine

At the 7th European Machine Tool Exhibition, held recently in Brussels, the Huron tape-controlled milling machine shown in the accompanying close-up view was included among the exhibits of Ferranti, Ltd., Ferry Road, Edinburgh 5. This heavy-duty machine, built by Leon Huré, Paris, (Rudolph Carne & Co., Ltd.) has been specially adapted to suit the Ferranti system, which gives 3-dimensional control. Re-circulating ball screws are provided for moving the table longitudinally on the knee, also the knee vertically, and the spindle head transversely.

The machine has a working capacity of 59 by 27 by 19 in., and feed rates to the longitudinal and transverse motions are steplessly variable up to 15 in. per min. For the knee motion, the maximum feed rate is 7½ in. per min. The universal spindle head can be swivelled through 360 deg. in each of two planes which are mutually inclined at 45 deg.

Two workpieces are shown clamped on the table, the lower being a large plate in which a peripheral groove was machined under 2-dimensional tape control, also various irregularly-shaped areas. At the centre may be seen a die block, in which a cavity was machined with a ball ended cutter, under 3-dimensional tape control.



A close-up view of a Huron/Ferranti tape-controlled milling machine at the 7th European Machine Tool Exhibition

Some Applications of Fractured Race Ball Bearings

A BALL BEARING with its outer race intentionally split may offer advantages to the designer where it is required to support maximum radial loads, in addition to thrust loads from either direction, with single-row construction. In external appearance, the split type closely resembles a conventional bearing, but there are internal differences. Fractured-race ball bearings in all precision grades are made by Split Ballbearing, Lebanon, N.H., U.S.A., a division of Miniature Precision Bearings, Inc.

The advantages of these bearings result from the fractured-race manufacturing process. By the simple (patented) expedient of splitting the outer race, the raceway can be completely filled with balls without the need for a loading slot or counterbore. When a retainer is required a one-piece precision-machined component of any desired material may be used. Such a retainer is pierced with as many radial holes as the web section between the pockets will allow, to enable a maximum complement of balls to be inserted, which usually fills about 90 per cent of the raceway. By comparison, only about 60 per cent of the raceway can be filled when bearings are assembled by the conventional method whereby the inner race is moved eccentrically against the outer race to permit the insertion of balls.

Because ball bearings made by the split-race technique contain approximately 40 per cent more balls than conventional bearings of the same envelope dimensions, they are capable of carrying proportionately greater loads. Static load-carrying capacity of a particular size of bearing, as calculated by most formulæ, is proportional to the number of balls it contains. Dynamic load-carrying capacity is proportional to the number of balls to the two-thirds power.

Since the gain in service life of a bearing is proportional to the cube of the increase in dynamic load-carrying capacity, the increased ball complement will extend this life considerably. An example is afforded by an aircraft installation where bearing failure in an auxiliary generator resulted when a 100 per cent overload was imposed on the equipment. Although the bearings were designed for a 1,000-hour life, failure often occurred after only 30 hours of service. Corrective action—the installation of bearings of similar type of the next closer tolerance grade, and with 2-piece machined-bronze retainers—did not appreciably extend operating life.

Split ball bearings were then installed. At first, they were used on only a few generators. After they had proved to be satisfactory, the bearings were employed on all units in aircraft of that type. Theoretical calculations, using conventional ball-bearing formulæ, showed that with the new bearing (with the same approximate external dimensions) there should be an increase in life of 700 per cent. Under test they operated for 1,000 hours (with a 100 per cent overload as required by the specification) with no sign of failure. Bearing speeds on the idler gear-shaft were 2,000 r.p.m. and on the generator drive-shaft, 6,000 r.p.m.

LOW-TORQUE CHARACTERISTICS

A large ball complement ensures significantly lower starting and running torques under conditions of heavy loading. The additional number of balls reduces the unit load per ball with the result that the ball-to-race contact is reduced, and a closer approximation to a true rolling surface is obtained for any given load.

The maximum ball complement may be used with precision one-piece retainers of bronze, phenolic-impregnated linen (Fig. 1), or stainless steel, at high speeds. Where a retainer cannot be used in some of the integrally shielded designs, alternative undersize balls can be inserted in the raceway to permit speeds up to 4,000 r.p.m. in most cases, and as high

Fig. 1. A fractured race bearing with a one-piece retainer is recommended for low-torque applications

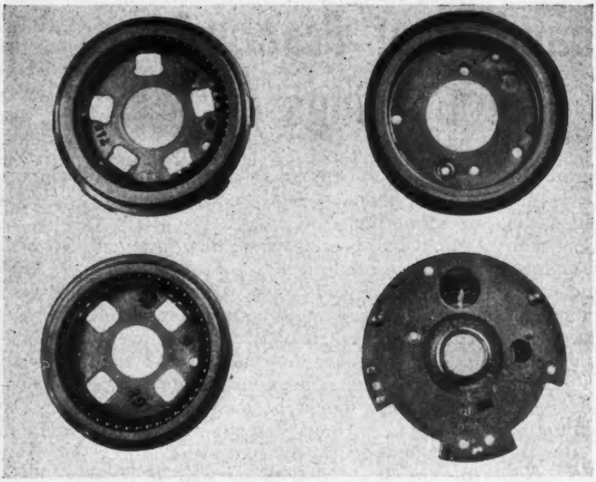


Fig. 2. Examples of Dyna-Flyte replacement distributor plates for motor vehicles. Each incorporates a split-race thin-section ball bearing

as 6,000 to 8,000 r.p.m. for many applications.

SMALLER LIGHTER MACHINES POSSIBLE

Often, when a smaller bearing can be used, the overall dimensions and weight of a machine or an assembly can be reduced. Compactness may be a very important advantage since unnecessary size represents an expense to the machine manufacturer during production, handling, and storage.

It was found possible, for example, to reduce the diameter of hand-operated air-powered ratchet wrenches by 50 per cent, because of the smaller size of the fractured-race ball bearing used. These wrenches are made by the Gardner-Denver Co., Quincy, Ill., U.S.A., and the smaller size enable the field of application to be extended as compared with that possible with a larger tool.

The use of the thin-section bearing permitted the designer to maintain the dimensions of an internal cam dimension—a critical component of the tool upon which the bearing is mounted—while reducing the diameter of the housing. The bearing employed is a standard precision-ground, thin-section, double-row shielded type. This pre-lubricated bearing has the same envelope dimensions as a standard needle bearing which could not be used for this application because of the thrust load involved. The bearing is subjected to a 1,000-lb. load (radial and thrust) when the pneumatically powered wrench tightens a nut to the full rated torque. When running free, the speed of the tool is 2,000 r.p.m.

In replacement parts, bearings must often be

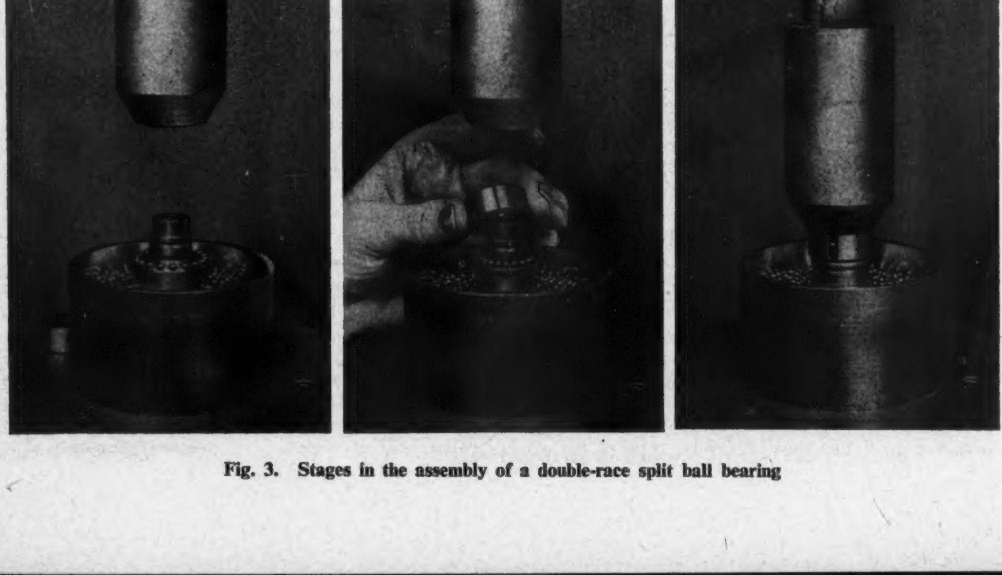


Fig. 3. Stages in the assembly of a double-race split ball bearing

designed to fit within a small space. One group of such parts consists of precision ball-bearing distributor plates intended to replace those used in standard motor vehicle ignition distributors. These Dyna-Flyte units (Renberles Products, Detroit, Mich.), examples of which are shown in Fig. 2, incorporate thin-section ball bearings of split design. For this application bearings must sometimes be made to an internal tolerance of only 0·0001 inch. Temperature variations are also severe—from −50 to +200 deg. F.—and continuous vibration and shock loads are part of the normal operating environment.

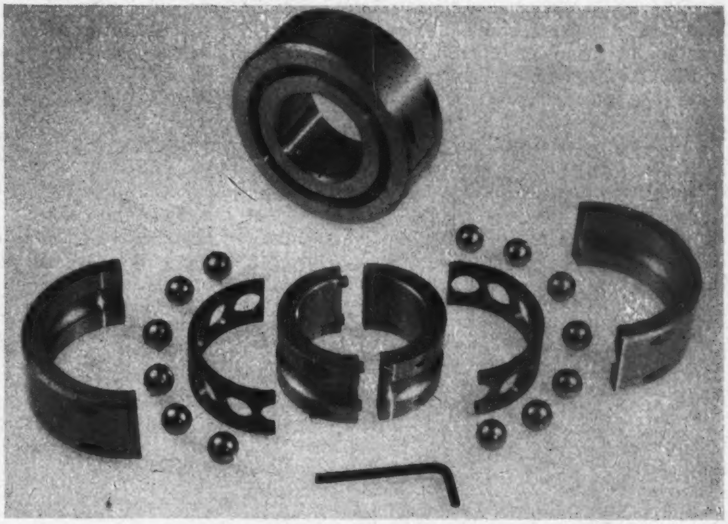


Fig. 4. Double-fracture ball bearings of this type can be assembled in positions where solid-race bearings could not be employed

The method of assembling a double-race split ball bearing is of interest. Referring to Fig. 3, after an inner race has been inserted in the assembly fixture, a full complement of balls for the lower race-way is brought up as seen in the view on the left. Next, the ball carrier is retracted, and the fractured outer race is added, as seen in the central view. Another full complement of balls is now brought up and allowed to fall against the inner race. Pressure is then applied to the outer race which causes the fracture to open. As a result, the upper row of balls is permitted to fall into place in the raceway. At the same time, the outer race is caused to slide over the lower row.

BEARINGS FOR USE IN CORROSION CONDITIONS AND AT HIGH TEMPERATURE

When they are to be subjected to corrosive conditions, 440C stainless steel is recommended as a material for fractured-race bearings. The one-piece retainer can be made from a material which is inert to the particular conditions involved. Retainers of K-Monel silicon-iron-bronze, phenolic resins, and various stainless steels have proved satisfactory for certain applications.

Auxiliary equipment required by the chemical, process, and aircraft industries must often operate at high temperatures. With temperatures not exceeding 450 deg. F., no serious difficulties are encountered with conventional 52100 bearing steel. For higher temperatures up to 900 deg. F. split-race bearings can be made from materials such as 440C stainless steel and the M series of tool steels.

Lubrication is, of course, a considerable problem at these higher temperatures. When necessary, for certain applications, split-race ball bearings can be run dry, but the anticipated life is then drastically reduced. In some instances dry lubricants have given satisfactory results.

Contrary to what might be expected, the split race is not a weak feature of the bearing. In practice, this type of bearing performs as if the race had not been fractured at all. No special precautions are required as regards mounting or load application (with the possible exception of press-fitting the outer race under conditions of heavy thrust).

When these bearings fail as a result of fatigue, or are intentionally tested to destruction, they fail in the same ways as do conventional bearings. Of the many theories advanced, one is most commonly accepted. When the outer race is fractured, the resulting surfaces have series of jagged points. On closing the outer race, the jagged points fit into corresponding depressions in the opposite faces of the fracture, and the former smoothness of the race is fully restored.

In the double-fracture split bearing, as shown in Fig. 4, both the inner and outer races are split to

permit rapid replacement, for example, at the centre of a shaft or crank. The parts are held together by means of tapered sleeves and screws, and the entire bearing—comprising the inner race, outer race, retainer and the complement of balls—is easily assembled around the mounting surface. The major drawback is cost, as the manufacture of such bearings involves considerably more work.

Double fracture bearings can be loaded with full complements of balls and enable designs to be adopted which would be difficult, or impossible to employ if it was necessary to incorporate conventional bearings.

A Tube-bending Die

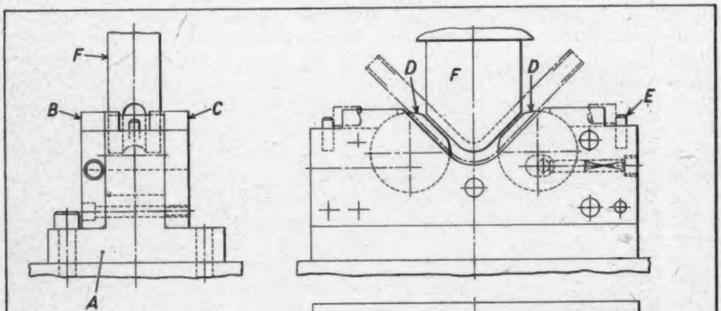
By M. W. LOFTUS

The tool shown in the accompanying figure was designed for use on a punch press, for bending seamless steel tubing without causing wrinkling, scratching or galling. As indicated at *A*, the body of the tool is of inverted-T section, and there are two side plates, as at *B* and *C*. These plates serve to house bearings for two pivoted disc-shaped blocks *D*, which are free to rotate about horizontal axes. Each block has a flat machined at one portion of the periphery, and extending longitudinally along this flat there is a groove of the same radius as the tube to be bent.

At the start of an operation, the pivoting blocks are disposed with the flats uppermost, and horizontal, and a piece of tube is laid in position so that it registers in the grooves and is located endwise by stops *E*. The ends of a portion of straight tube are shown chain-dotted in the figure. A punch *F* is secured to the press ram and as the latter is brought down, the nose of the punch strikes the workpiece and starts to bend it.

As the tube bends, and the ends sweep upwards and together, the blocks *D* pivot about their horizontal axes and wrap the tube around the form on the punch. After the ram has been raised, the tube is removed, and the blocks *D* are automatically returned to the starting position by means of spring-loaded plungers as at *G*. Each plunger is housed in a bore in the plate *C* and its nose contacts a small peg *H* projecting from one side of the block *D*.

Depth stops, not shown, can be provided to limit the downward travel of the ram, and thus control the angle to which the tube is bent.



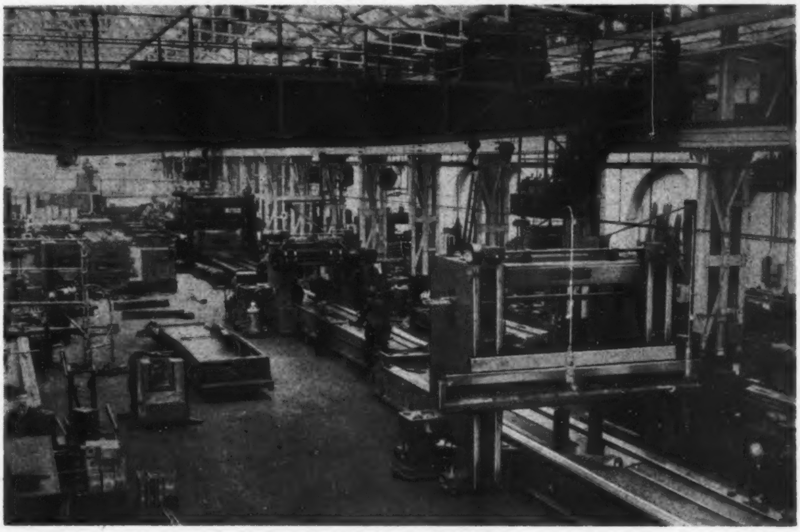
A die for bending seamless steel tube on a punch press

Sinter Seal Impregnation Process. Industrial Impregnations, Ltd., Willow Road, Poyle Estate, Colnbrook, Bucks., have developed the Sinter Seal process for impregnating sintered metal parts as a means of preventing internal corrosion.

The material used for impregnation is a specially-compounded resinous mixture which is stated to be completely stable in the fully-cured state. An impregnated component will withstand temperatures up to about 200 deg. C. without its efficiency and chemical resistance being impaired.

Increase in weight of the component as a result of impregnation depends upon the density of the original part. No dimensional changes occur as a result of the treatment, and the original colour is retained. Sintered parts, after impregnation, have been found capable of withstanding gas pressures up to 100, and hydraulic pressures up to 1,000 lb. per sq. in. Impregnation of parts that are to be electroplated prevents absorption of the solution, and permits a better finish.

MACHINE TOOL BUILDING IN BRITAIN—3



The Butler Machine Tool Co., Ltd., Mile Thorn, Halifax

By P. A. SIDDERS, Chief Associate Editor

A MACHINE TOOL BUILDING BUSINESS was established at Halifax in 1868, under the title of J. Butler & Co. The founder, James Butler, had been trained as a mechanic with a firm engaged in carpet manufacture, and was eventually foreman of the Jacquard department. From his training and experience in connection with carpet making machines, he became familiar with intricate mechanisms, and in particular, with cam-actuated systems for developing straight-line movements, and this knowledge proved useful when he started to build machine tools on his own account.

As was customary for machine tool firms in the latter half of the 19th century, the Butler company built a wide range of different types of machines. Conditions during the 1914-1918 war led to a certain amount of rationalization within the machine tool industry, however, and in 1917, the company was one of the founder members of the Associated British Machine Tool Makers, Ltd. As a result of this association with other well-known machine tool builders, the company was able to concentrate on the design and production of machine tools with reciprocating action, with the result that the name of Butler has become universally associated with planing, shaping and slotting machines.

The opportunity was taken to improve designs, initiate batch production, and establish interchangeability of components through the extensive use of special-purpose equipment, jigs, fixtures, and gauges. Among improvements made in connection with Butler machines may be mentioned the increase of cutting speeds, particularly to meet the requirements of tungsten carbide tools, and improvements in accuracy, to permit precision planing and shaping operations.

The Butler Machine Tool Co., Ltd., has always been very much a family business, and the founder

(Continued on page 1371)

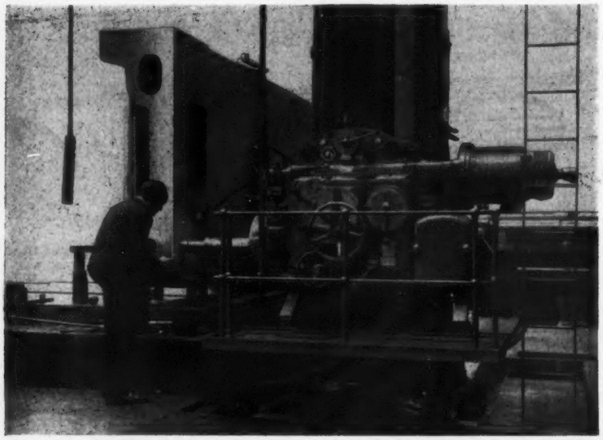


Fig. 1. Boring a location hole for a feed bearing bracket in the upright for a Butler No. 8 Spiral-Electric planer on a 6-in. spindle, Asquith floor-type machine. The cored hole is first rough machined, then finished to 5 in. diameter, ± 0·0005 in. using a Microbore tool, with a high-speed steel cutting bit, which is run at 100 r.p.m., and fed at a rate of 0·008 in. per rev. This Asquith borer is also used for facing the ends of the upright, with a 16-in. diameter cutter mounted directly on the facing head of the spindle. A speed of 50 r.p.m. is employed, and from ½ to ¾ in. of metal is removed from each surface

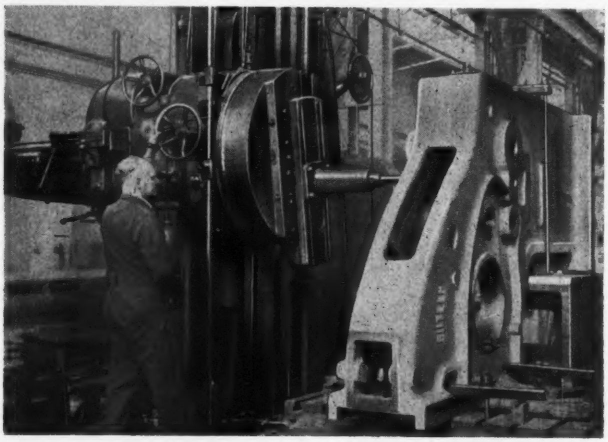


Fig. 2. Snout boring the body for a 21-in. slotting machine on a Richards No. 5 horizontal borer in 'A' department of the Mile Thorn works. The holes being machined are of 3·750 and 2·875 in. diameter, ±0·001 in., and receive phosphor bronze bushes on assembly. The large hole in the body is snout bored to 17·500 in. diameter, —0, +0·005 in. at a cutting speed of 75 ft. per min. and a feed rate of 0·009 in. per rev. When the boring operations have been completed, the machine table and work are indexed through 90 deg. and the base surface (remote from the camera, at the right) is machined

Fig. 3. During erection in the heavy bay of 'A' department, the alignment of the bed, cross rail and uprights of this Butler No. 8A Spiral-Electric planer is checked by Taylor-Hobson equipment. An alignment telescope and target (seen at the left on the bed), are used first to check the straightness of the bed-ways at a series of positions along their length. A right-angle prism attachment is then fitted to the telescope and a line target (seen directly above the inspector) is secured to the cross rail with the aid of permanent magnets. The alignment of the cross rail is then determined, with reference to the previously established optical axis, at the right, centre and left of both slideways

Fig. 4. This Churchill slideway grinder in 'F' department has two heads on the cross rail and one on the upright. It is seen set up for grinding the guideways on the upright for a Butler No. 7A planer. All faces are ground at one setting in a total time of approximately 16 hours. The outer vertical flat faces (extreme left in the illustration) are ground first, then the upper horizontal face and the lower dovetail face (as shown). A vertical face adjacent to the dovetail face and a narrow face parallel to the upper outer vertical face are ground next, after which the inside horizontal face is ground parallel to the upper horizontal face

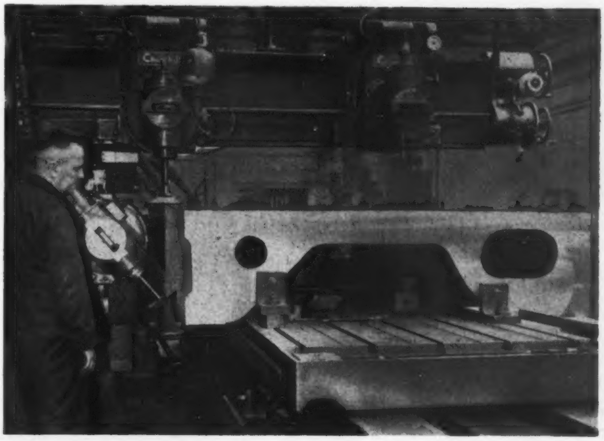


Fig. 5. This set-up on a Churchill slideway grinder with a 6- by 2-ft. table provides for finishing the bearing surfaces on the outside and inside of an annular rib on the swivel slide for a Butler No. 7A planer. A motor-driven rotary table is mounted on the main table of the machine, and the cast-iron workpiece is rough ground by a combination of the rotary and longitudinal feed motions. For finishing, the feed motion of the rotary table only is used, and the surfaces are covered in a number of stages. If required, surfaces can be ground slightly convex or concave

Fig. 6. Angle faces on swivel slides and down-feed slides which receive the retaining strips are ground simultaneously at this set-up on a Churchill machine to ensure correct seating of the strips, and in consequence, subsequent fitting at the erection stage has been practically eliminated. The V-guides on the down-feed slide are ground first, and the mating slideways on the swivel slide are then ground to suit. The swivel slide is mounted in a fixture and the bearing of the two parts is checked by blueing. When the two slides have been correctly bedded, the down-feed slide is mounted on the swivel slide and the angle faces are then ground

Fig. 7. Two of the Asquith radial drilling machines in 'D' department of the Mile Thorn works. A type OD 1 machine is seen in the background, and the type OD 3 machine in the foreground is set up for operations on a saddle for a Butler 18-in., shaper. With the aid of a universal indexing jig, a total of 18 holes, from $\frac{5}{16}$ to 2 in. diameter, is drilled in the ends, an intermediate wall and one side. Three holes are tapped $\frac{1}{2}$-in. B.S.F., and the hole in the side is spotfaced

Fig. 8. A recently-installed Milnes fine-boring machine, with Hilger & Watts optical positioning equipment, is here seen set up for operations on two table worm brackets for Butler 21-in. slotting machines. In-line bearing seats are first drilled, then bored to 1·250 in. diameter -0, $+0{\cdot}0005$ in., using a Microbore tool, the speed and feed rate for finishing being 300 r.p.m. and 0·005 in. per rev. Aluminium feed brackets for 36-in. openside planers are bored complete on this machine. There are holes and counterbores of 16 different diameters, from $1\frac{1}{4}$ to $3\frac{1}{2}$ in., in these components

Fig. 9. Cutting a slot, $2\frac{1}{2}$ in. wide by 1 in. deep, in the ram for a Butler 48-in. draw-cut shaper, on one of the company's 4- by 4- by 10-ft. openside, Spiral-Electric planers. The workpiece is a forging in 0·4 per cent carbon steel, and the slot is blind-cut into a transverse groove, $1\frac{1}{16}$ in. wide. High-speed steel tools are used, at a cutting speed of 70 ft. per min. A $\frac{3}{4}$-in. wide tool is employed for roughing, at a feed rate of 0·024 in. per stroke, and the sides of the slot are then machined to width at the same set-up

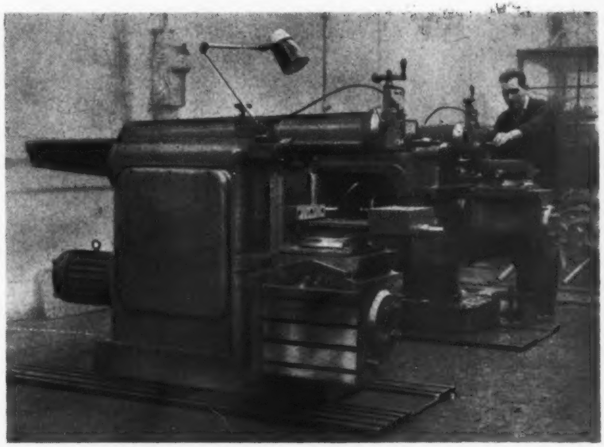


Fig. 10. Two of the test stands that are let into the floor of 'D' department. Butler 18-in. hydraulic shaping machines are seen undergoing tests, and the machine in the background is taking a $\frac{3}{8}$-in. deep test cut in a mild steel block, at a cutting speed of 45 ft. per min. and a feed rate of 0·021 in. per stroke. The machines are fitted with vices and combination tables, which permit tilting and swivelling in three planes. Shaping machines of this type are built in batches of 16

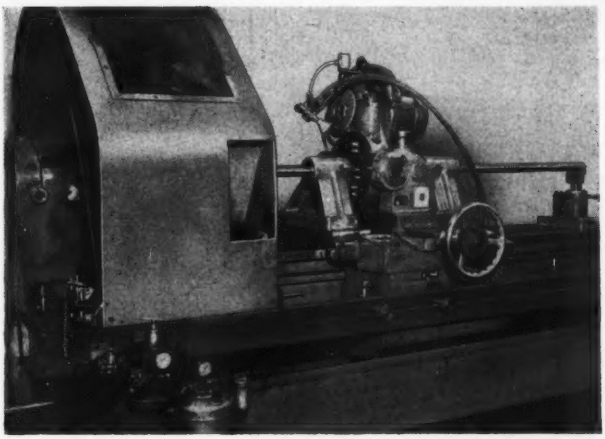


Fig. 11. Set up for cutting the thread in the cross-slide traversing screw for a Butler No. 7A planer, on a Binns & Berry thread-whirling lathe equipped with a Burgsmuller head. This thread is of Acme form, 12-mm. pitch, and 2-start, and is 10 ft. long. The starts are machined separately, each in two cuts, at a traverse speed of $2\frac{1}{2}$ in. per min., 0·025 in. of material per flank being removed during the second cut. The cutter head is run at 1,800 r.p.m., and is fitted with four cutters, two of 20 deg. included angle, one of 29 deg., and one for chamfering. Atomized gear cutting oil is applied as a coolant

Fig. 12. This Pfauter spline hobbing machine has been fitted, by Butler, with a special end-support for the work, in place of the tailstock. The support incorporates an internally splined bush, which runs in plain bearings, and it enables splines to be machined on shafts of any length. The Pfauter machine is seen set up for cutting six splines of B.S. straight-sided type, in the 2-in. diameter side shaft for a 21-in. slotter. A 3-in. diameter, single-start hob is used, which is run at 180 r.p.m.. and the feed rate is 0·010 in. per rev. of the work. In the same area there is a Dowding & Doll spline hobbing machine

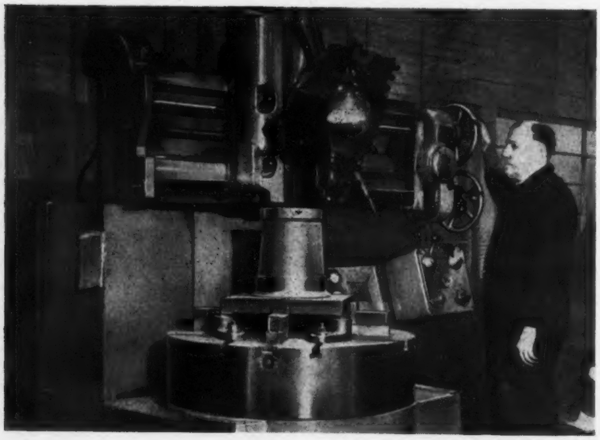


Fig. 13. A Webster & Bennett 36-in. vertical turning and boring mill in the main machine shop of the Mile Thorn works is here seen set up for machining the pillar for an 18-in. universal table. The operations include turning two bearing portions of 9 and 10 in. diameter, facing the upper surface of the base, facing the upper end of the pillar, and boring the pillar 4·250 in. diameter, ± 0·001 in. Tungsten carbide tipped tools are used, and the work is first rough machined all over at a speed of 39 r.p.m. and a feed rate of 0·037 in. per rev. It is then finish machined at 55 r.p.m. and 0·010-in. per rev. feed, and boring is performed at 72 r.p.m. and 0·010-in. feed

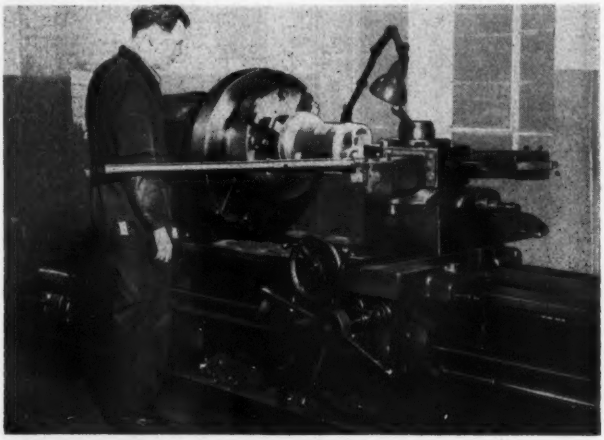


Fig. 14. This Lang 30-in. swing surfacing and boring lathe is equipped with a special fixture for boring gearboxes. The front portion of the fixture is arranged to slide, and a location plunger passes through this front portion into the back plate, to ensure that the holes are machined on the correct centres. In each gearbox there are two pairs of in-line holes which are finished with floating-type cutters to receive Hoffmann bearings. The 2½-in. diameter hole which is here being machined, is finished at a speed of 32 r.p.m., and a feed rate of 132 cuts per in.

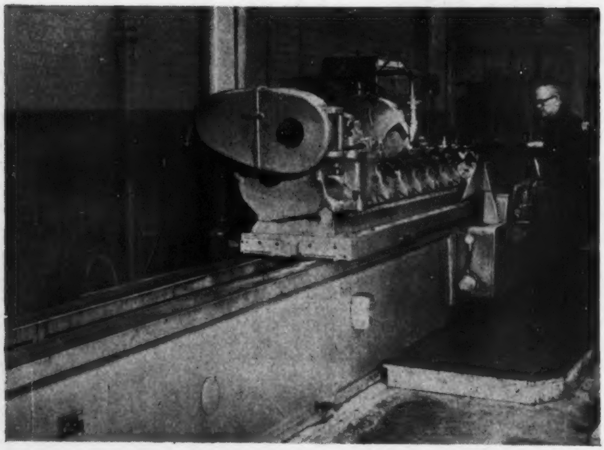


Fig. 15. This large Churchill plain grinding machine has recently been installed in the main machine shop of the Mile Thorn works, and has a 12-in. swing capacity. It has a 16-ft. long table and is intended for grinding main drive shafts and screw blanks more than 10 ft. long. The grinding wheel is 28 in. diameter by 3 in. wide, and the table speeds range from 4 to 123 in. per min., and the work speeds from 18 to 110 r.p.m. Here, the machine is seen grinding the blank for a bed screw in 0·5 per cent carbon steel. The work is 6 ft. 4½ in. long, and has six steps, including a portion 2½ in. diameter by 4 ft. 7½ in. long, which is subsequently threaded

Fig. 16. Equipment in the gear cutting section includes this Butler-built automatic indexing slotter, which has a maximum stroke of 5 in., and will cut gears up to 14 in. maximum diameter, using a formed single-point tool. It is also used for producing ratchet and saw-type teeth, and an attachment is available for cutting teeth on the faces of such parts as dog clutches. The machine is seen set up for cutting 24 internal teeth, of 8 d.p., in a clutch for a 6-ft. hydraulic openside planer. The stroke length is 1½ in., and the machine runs at 65 cycles per min., with a feed rate of 0·004 in. per cycle, the cutting time for the complete gear being 15 min. Speeds up to 200 cycles per min. are obtainable and the feed rates range from 0 to 0·006 in. per cycle

Fig. 17. This rig for checking squares has been built and installed in the toolroom of the Mile Thorn works. A bed with an accurately flat upper surface has a column at the rear to support a strip, the edges of which are parallel within very close limits. At either side of the column there are troughs wherein are fitted electric lamps. The stock of a square to be checked is mounted on the bed, and the blade is brought into contact with one side of the parallel strip, which is adjusted to obtain light tightness. Then, the square is repositioned with its blade in contact with the other side of the strip, and if the square is correct, no light should be visible between the blade and the strip. The strip can be raised for checking the inside edge of the blade in a similar manner

was succeeded by his son Mr. Harold Butler, M.B.E., who was at one time joint managing director with his brother, Mr. Herbert Butler. Mr. James W. Butler and Mr. Geoffrey M. Butler, sons of Mr. Harold Butler, are now joint managing directors, the former being chairman, also chairman of Associated British Machine Tool Makers, Ltd. The firm has two works in Halifax, one at Adelaide Street and the other at Mile Thorn, and it is with the latter that this article is concerned. It may be mentioned here that the Adelaide Street works, in which the company operated originally, now house the pattern shop, general pattern stores, foundry and welding department, and have an area of approximately 40,000 sq. ft. The foundry has an output of some 1,000 tons per year, exclusively in cast iron, and supplies about half the castings required by the company. The remainder, particularly castings for the largest machine components, are obtained from other foundries in the Halifax area.

Mile Thorn works are built on a site of about 5½ acres, and the first group of buildings was completed in 1917. The buildings have since been considerably extended, and the latest addition to the production area was the machine shop which was finished in 1950. All machine tools previously installed at the Adelaide Street works were then moved to the new building, and machining and erection have since been carried out at the one site. Adjacent to the main workshops at Mile Thorn there is a modern office block, mainly of

single storey construction, and a new drawing office was added to this block two years ago. This office is in accordance with the latest standards, and has an area of 6,000 sq. ft. Good natural lighting is provided by fibreglass panels in the roof, and the windows are double-glazed. Hydraulically-operated adjustable stands are provided for the drawing boards, all of which are equipped with draughting machines.

The total number of workpeople employed by the company, which rose to a peak figure of 600 in 1943, has remained at about 400 for some years, and, in addition, there is an office staff of 45, including 12 draughtsmen and a number of drawing office apprentices.

Mile Thorn works are divided into a number of departments, and "A" department is concerned with the building of planers. A general view of the heavy erection bay of this department is given in the heading illustration, and at the right may be seen a No. 8A spiral drive planer under construction, with a heavy-duty rail planer to the rear. The latter machine has a 25- by 5-ft. tilting table —seen on the floor to the left—which can be set to a maximum inclination of 1 in 30. A second rail planer, with a 36- by 5-ft. table is under construction at the extreme left. There is also a second bay in "A" department for the building of medium-size planers, and the total area of the department is 28,600 sq. ft., the height to the roof trusses being 28 ft. Two overhead travelling cranes, of the company's own design and construction, are installed in each bay, those in the heavy bay having hoists of 15 and 3 tons capacity, and in the medium bay, of 12 and 5 tons capacity. A number of heavy-duty planing and boring machines is installed in the department, and set-ups on some of these machines are shown in certain of the accompanying illustrations.

Butler high-production slotters are built in "B" department which has an area of 10,000 sq. ft., and an adjacent shop houses "C" department, which is devoted to 26 in. shapers and openside hydraulic planers, also "D" department for building 18-in. shapers. All these departments are well equipped with overhead travelling cranes, and, again, the height from floor to roof trusses is 28 ft. The combined area of "C" and "D" departments is 12,400 sq. ft., and since the latter department is concerned with smaller, lighter components, there are two 3-ton capacity travelling cranes which run on rails that are supported on floor-mounted pillars, below the main overhead cranes.

Adjoining these departments is a bay which houses "E" and "F" departments, which have a combined area of 14,000 sq. ft. Precision slotters are built in "E" department, where the height from the floor to the roof trusses is 19 ft., whereas "F" department, where the height is 28 ft., forms an extension of the machine shop and houses six Churchill slideway grinding machines. The capacities of these machines range from 8 by 2 by 2 ft. to 16 by 4 by 4 ft., and some typical grinding set-ups are illustrated. Other equipment in this department includes two large Kendall & Gent milling machines, a Richards vertical turning and boring mill, and three Butler openside planing machines—one of 10 by 4 by 4 ft. capacity and two of the 36-in. type.

The well-equipped main machine shop has an area of 25,000 sq. ft., and the equipment includes a large battery of Ward machines, ranging from No. 10 combination turret to No. 2A capstan lathes. Among other lathes may be mentioned a large group by Lang, a Swift type 11B with a 24-ft. long bed, a type 15V5 by the same maker, of 10-ft. by 15-in. swing capacity, with a gap bed and a pentagon tool holder on the compound slide, and two profiling lathes, one by Lang and the other by Churchill-Redman. A large number of Churchill plain grinding machines is installed, and a recent addition is a machine of 12-in. swing with a 16-ft. long bed for grinding main drive shafts and screw blanks over 10 ft. long.

Gear cutting equipment includes a No. 19, a No. 16, and two No. 5B Sunderland machines, a No. 3A Maxicut shaper, a 12-in. Gleason bevel generator, and a Butler automatic indexing slotter. There are Pfauter and Dowding & Doll hobbing machines for generating splines, and a Lapointe type H.P.30 horizontal hydraulic broaching machine with a stroke of 66 in. and a maximum pull of 30,000 lb., for cutting internal splines and similar work.

A toolroom adjoins the machine shop, and is equipped with a Newall type 2436 jig borer, and a wide range of precision lathes, milling machines and other units. Auxiliary equipment includes a Delapena honing machine and a Wild Barfield tool hardening furnace. An Abwood universal circular dividing machine is used for marking circular scales on indexing rings, dials, graduated collars, and similar parts.

As has already been indicated, Butler machines are built in batches, and unit construction is employed wherever possible. Typical examples of batch sizes are 16 for 18-in. Super shapers, 12 for 26-in. Super shapers, 8 for 8-in. precision slotters, and 4 for 3-ft. 0-in. hydraulic openside planers. The number of Spiral-Electric planers is governed by the erection area, which will accommodate a total bed length of approximately 300 ft. Some representative machining and building operations at the Mile Thorn works are shown in the accompanying illustrations.

T.I. Helicoidal Bearing

Made by La Technique Integrale, 18 bis, rue d'Anjous, Paris 8me., France, the T.I. Helicoidal Bearing is primarily intended for converting from rotary to linear motion, and a sectioned elevation of a typical unit is seen in Fig. 1.

Mounted concentrically with the screw *A*, the nut *B* houses a series of rollers as at *C*, which are arranged with their axes parallel with that of the unit and can rotate in corresponding holes in cage rings at the ends of the nut. The rollers are prevented from moving axially in the nut, and threads on their peripheries are engaged with the threads on the screw and in the nut, for transmitting motion between the latter members. To obviate the risk of slip between the rollers and the threads in the nut, which might otherwise occur due to the working clearances and would give rise to effective axial play, teeth on the periphery close to the ends of each roller are meshed with corresponding teeth in the bore of the nut.

A thread form with crowned flanks is employed, to reduce the area of contact, and it is claimed that relative motion between the nut and the screw is obtained with virtually no sliding friction. Motion is thus transmitted with high efficiency, as will be evident from the graph in Fig. 2, where a comparison is shown between the efficiencies of Helicoidal Bearings and conventional screw and nut assemblies with threads having various helix angles. The efficiency is such that motion can also be transmitted in the reverse direction, namely, by traversing one member to cause rotation of the other. Further advantages claimed for the system include high resistance to wear, and the ability to transmit high loads without the risk of seizure.

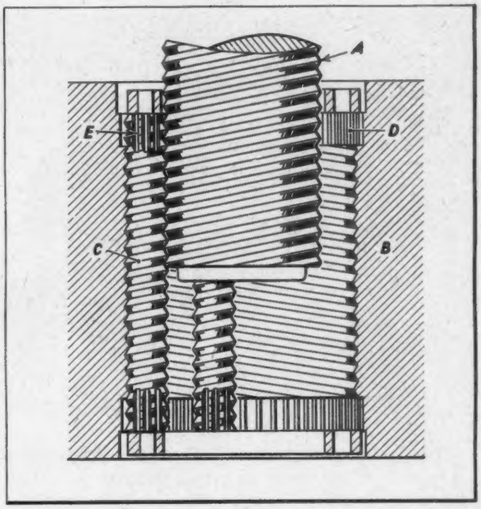


Fig. 1. Sectioned elevation of the T.I. Helicoidal Bearing, for converting from rotary to linear motion, or vice versa

Units can be made for a maximum travel from 1 in. to approximately 16 ft., for static loads up to 100 tons, and the rotating member can be driven at speeds from 2 to 3,000 r.p.m. In the standard series, which includes units with screws from 8 to 72 mm. ($\frac{5}{16}$ to $2\frac{27}{32}$ in.) diameter, the dimensions of the nut range from 1 in. diameter by $1\frac{1}{4}$ in. long up to $5\frac{5}{8}$ in. diameter by $4\frac{17}{32}$ in. long. An example is shown in Fig. 3, the nut having been cut away to expose some of the rollers, and as an indication of the capacity, it is stated that at working speeds up to 300 r.p.m., for the smallest and

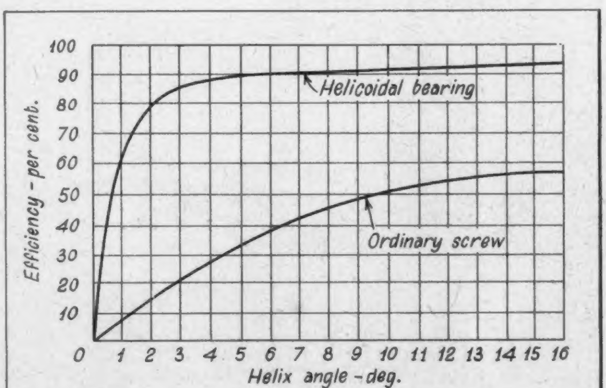


Fig. 2. Comparison of the efficiency of Helicoidal Bearings and conventional screw and nut assemblies

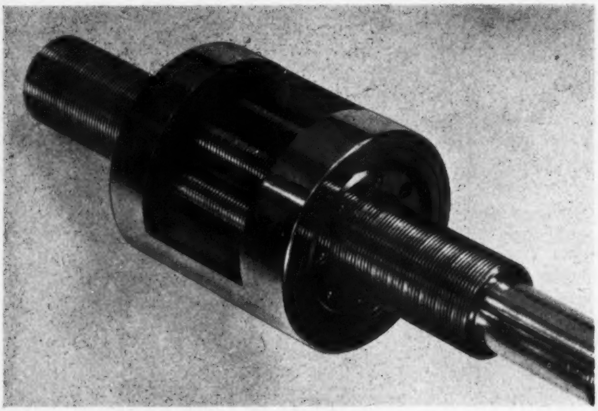


Fig. 3. A typical Helicoidal Bearing is here shown with the nut cut away, to expose some of the rollers

largest units, the maximum tensile loads may be about 4 cwt. and 29½ tons.

Units can also be supplied for special purposes, and the nut may be incorporated in a member with an external form to suit requirements. To prevent movement in the reverse direction under load, as is necessary when the screw is employed for jacking, for example, a uni-directional roller clutch can be built into the nut. Thread pitches normally range from 4 to 15 mm. (0·158 to 0·530 in.), and it is stated that, if required, provision can be made for a differential action to enable a small linear movement per rev. to be obtained with threads suitable for transmitting high loads. It is claimed that the speed reduction which is thus provided permits considerable economies in connection with the system whereby drive is transmitted to the rotating member. It should be noted, however, that the accuracy of linear motion obtained with such a unit is not higher than 2 per cent.

The units have been applied by French companies in a wide variety of industries, and reference may be made particularly to their incorporation in machine tools built by several well-known firms. A unit for applying motion to the work-table of a milling machine, for example, has a nut which is constructed in two parts, to permit play to be taken up during climb milling operations.

Rhodes Up-cutting Hydraulic Shears

In the figure is shown an up-cutting shears incorporating the company's patented Fluid-Drive principle, which has been supplied by Joseph Rhodes & Sons, Ltd., Grove Ironworks, Wakefield, to Samuel Fox & Co., Ltd., Stocksbridge, Sheffield. The shears was designed specially for inclusion at the end of a "cut-to-length" automatic line, and are capable of shearing up to 1-in. thick mild steel, or ¾-in. thick stainless steel, in widths up to 6 ft. 6 in. The cutting rate of the shears on plate up to ⅝-in. thick is 20 strokes per min., and the maximum rate on thicker plates is 6 strokes per min.

With the Fluid-Drive method of operation, there are no clutches, rotating shafts, gears, or flywheels, and a relief valve in the hydraulic circuit ensures that no damage can occur from overloading.

Because the shears are of the up-cutting type, the line conveyor can be maintained at a constant height. Use of the orthodox down-cutting shears would have necessitated the provision of an automatic dipping conveyor at the outgoing end of the line.

Rhodes up-cutting hydraulic shears for stainless steel plate

Continuous Broaching Root Forms on Turbine Blades

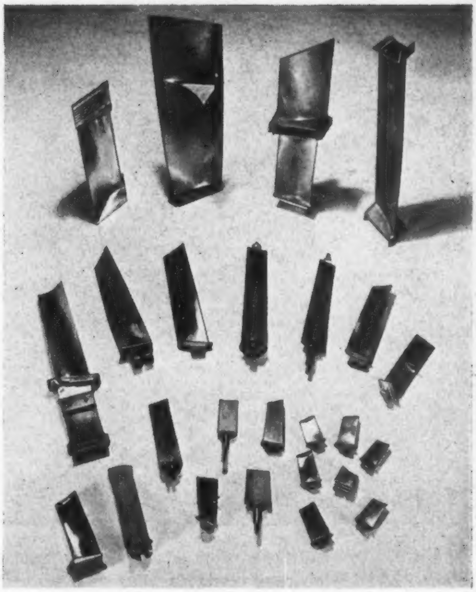


Fig. 1. Some typical blades on which the root forms are machined by continuous broaching

AT THE TAPCO AIRFOILS WORKS of Thompson Ramo Wooldridge Inc., Cleveland, Ohio, U.S.A., root forms are being machined economically on comparatively small batches of blades and vanes for gas turbines by continuous broaching. These components, some examples of which are shown in Fig. 1, are made in a great variety of forms and sizes, with lengths from 2 to 16 in., and in many different materials. including, aluminium alloy, 403 stainless steel of 30 Rockwell C hardness, A-286 alloy, titanium, and Hastelloy.

It has been found that broaching is essential to produce the intricate forms required with the necessary accuracy, and that the continuous process offers important advantages. A battery of Foote-Burt machines has been installed for this work, some of which are seen in Fig. 2, and their ratings range from 10 to 30 h.p. with maximum cutting lengths from 40 to 110 in.

Certain blades although of different lengths have identical root forms, and three or four such blades may be handled at the same set up. For this purpose, the fixtures on the broach chain are arranged in groups, each fixture in a group being designed to receive a blade of a different length. The operator inserts the appropriate blade in each fixture as it passes the loading position, and as the fixture moves forward the blade is automatically clamped by the action of a cam. To protect the

Fig. 2. Part of a battery of Foote-Burt continuous broaching machines employed for operations on turbine blade roots

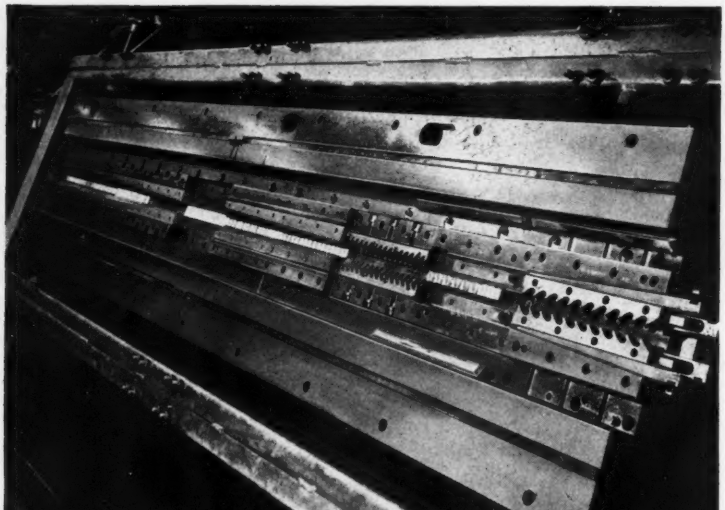


Fig. 3. The under-side of an interchangeable head for one of the continuous broaching machines with a set of broaches in position

broaches from damage, a safety gate is provided at the entrance to the tunnel, and if a blade has been inserted in the wrong fixture, or is incorrectly located and clamped, it will come in contact with the safety gate. As a result, a limit switch is tripped to stop the machine. The work clamping members of the fixtures can be rapidly interchanged to suit different blade forms.

To enable a different root form to be machined it is necessary, of course, to change the broaches, and to allow this operation to be economically performed, two broaching heads are normally provided for each machine. A view of the underside of one of these heads removed from the machine is given in Fig. 3, with a typical set of root-form broaches in position.

While broaching is being carried out with one head, the broach inserts in the other may be changed to suit the next batch of blades that is to be handled. Accurate pre-setting of the inserts is facilitated by the provision of taper gibs which enable very fine adjustments to be made. With the second broaching head thus prepared, it is stated, the time required for changing over is normally less than two hours.

Although it is desirable, where possible, to utilize the full complement of fixtures on the chain, and to broach two or more different blades with a common root form at one set-up, the continuous process is also employed in some instances for only one type of blade at a time. In these circumstances, groups of different fixtures are still provided on the chain, but only one fixture in each group is loaded. In this connection it is pointed out that the power required for broaching some of the special alloys is such that consecutive fixtures could not be loaded, even if suitable blades were available, because the capacity of the machine would be overtaxed.

Outputs obtained from the continuous broaching machines range up to 3,000 blades per day, and it is stated that tolerances on root form as close as 0·0005 in. are maintained in some instances. The roots of steel blades are finished by a grinding operation, but titanium blades can be broached to the required limits of accuracy and surface finish.

Blue Bird Typewriter with Tape Punching Unit.—At the recent Business Efficiency Exhibition at Olympia, a new German-built typewriter with a plug-in 5-channel punching unit was shown on the stand of Blue Bird Typewriters, Re-Man House, 44 Gray's Inn Road, London, W.C.1. This equipment enables punched tape to be produced simultaneously with the preparation of typewritten information, on stock record cards, for instance. The typewriter can be used for normal correspondence purposes when required.

Various typing programmes can be pre-set by means of a horizontal splined bar at the back of the carriage. Each spline represents a different programme, and certain portions are cut away. During typing, a solenoid plunger is depressed by the crest of the selected spline and an electrical circuit is thus completed so that information is transmitted to the tape. When a gap in the spline moves past the plunger, the latter is released and signals to the punching unit are temporarily interrupted. During this period, data not required on the tape is typed on the record card. Murray tape-code is used, and the equipment is suitable for use with the Telex system.

The Rodolite*

A new Optical Device for Checking Machine Tool Alignments

By J. DYSON, Sc.D., F.Inst.P., and R. J. TILLEN,† Grad.Inst.P.

Although the accuracy required in large machine tools is generally not very great, there are certain notable exceptions, and on a large gear-hobbing machine, for example, an error of 0·0001 in. may be important. Since conventional mechanical checks tend to be inconvenient and tedious, they are often omitted, and the results that are obtained by such methods are treated with some reserve.

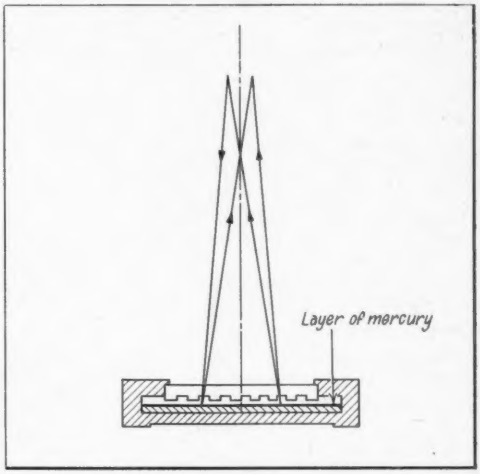


Fig. 2. The "optical plumb-line" mercury Rodolite, which is self-levelling

With the development of the "Rodolite"‡—a registered name derived from "rod of light"—an attempt has been made to provide a method of alignment-checking that is both more accurate, and more convenient.

OPTICAL PRINCIPLE

The instrument is based on the use of a circular diffraction grating comprising a large number of equally-spaced concentric rings. If a wave-front falls normally on such a grating, as at *A*, in the diagram at *X* in Fig. 1, a conical diffracted wave-front *B* is formed. In this diagram, it should be noted, other conical wave-fronts, corresponding to different orders of diffraction, have been omitted for the sake of clarity. The conical wave intersects itself at all points on the axis, as at *C*, and at each such point, there is a concentration of light.

Provided that the light-source is sufficiently small, the light-distribution at the intersection takes the form of a small light-spot surrounded by alternate dark and light interference rings, of successively diminishing intensity. With a perfectly made grating, and axially symmetrical illumination, the

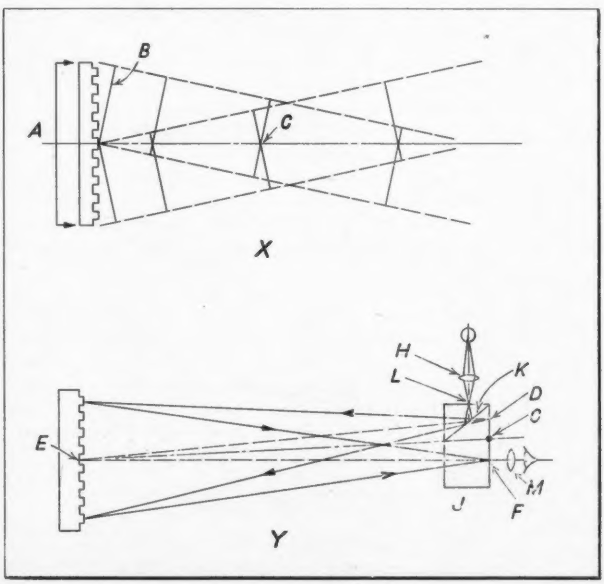


Fig. 1. *X*—Optical principle of the Rodolite. *Y*—The reflection Rodolite

* Abstract from a paper entitled "The Rodolite: A new Method for Machine Tool Testing, and Some Applications", presented at the Second International Machine Tool Design and Research Conference, Manchester College of Science and Technology.

† A.E.I. Research Laboratory, Aldermaston Court, Aldermaston, Berks.

‡ Rodolite equipment is being made under licence from A.E.I. by Cooke, Troughton & Simms Ltd., Yorks.

locus of these spots is straight. Although a "phase" grating, consisting of raised rings of rectangular cross-section, is used to ensure maximum light economy, the contrast between the central spot and the interference rings tends to become poor at extreme ranges. Nevertheless, a 1⅝-in. diameter grating, with 150 rings per in., enables settings to be made to this line within 0·0001 in., over a range of approximately 20 ft., with an eyepiece fitted with cross-hairs. The height of the raised portions of the phase grating, it may be noted, is such that the rays passing through the raised rings experience a path difference of half a wave length in relation to rays traversing the intermediate spaces.

Circular gratings can also be used reflectively, as shown in the diagram at *Y* in Fig. 1. Light from a small source *D*, near the axis, is diffracted to produce a concentration of light along the line *E-F*, where *E* is the centre of the grating, and *F* is at the same distance from the grating and the axis as *D*, but on the other side of the axis. The point *G*, which bisects *D-F*, is therefore always on the grating axis.

A convenient arrangement comprises a lamp and condenser *H*, and a compound prism *J*, which incorporates a reflecting surface *K*. A pin-hole or other pattern *L*, on a side face of the prism, then serves as the light-source. Setting is carried out by reference to cross-hairs on the rear face of the prism, which are observed through the magnifier *M*. When the prism is displaced sideways slightly, the cross-hairs, and the image *F*, move in opposite directions, so that the sensitivity of setting is doubled. With a 2-in. diameter, 400-line per in. grating, settings to 0·00005 in. can be made over a distance of approximately 20 ft.

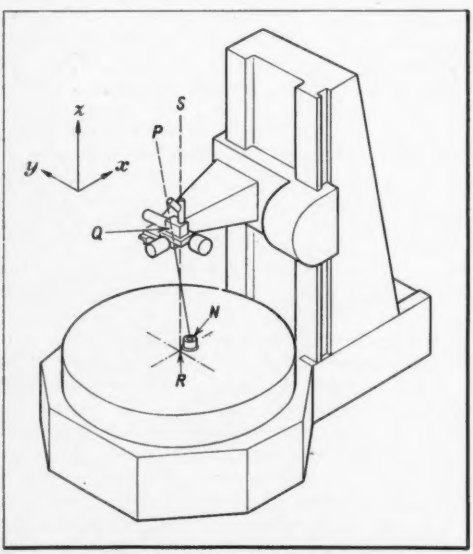


Fig. 3. Mercury Rodolite set-up on a hobbing machine for checking column and table-axis alignment

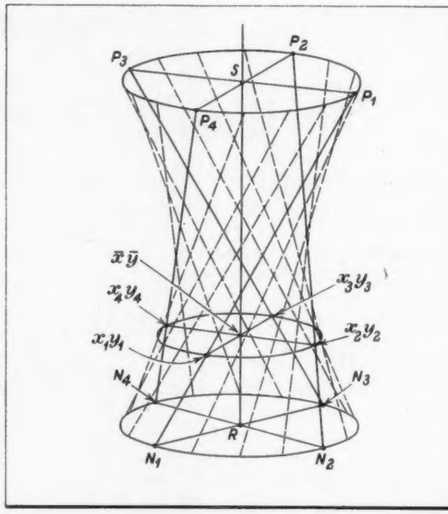


Fig. 4. Hyperboloid of revolution swept by the Rodolite line *N—P*, Fig. 3, on rotation about the work axis *R—S*

A third method, for which a transmission grating with rings of half the normal depth is required, is shown in Fig. 2. The grating is mounted close to a layer of mercury, approximately 0·010 in. thick, on the surface of an amalgamated silver plate, and provided that it is not tilted excessively, this combination behaves as a reflection grating which is always horizontal. Since the line defined thereby is always vertical, the device can, in practice, be regarded as an optical plumb-line. Accurate levelling is unnecessary, and the accuracy of setting, to the line, is the same as for an ordinary reflection grating of the same radial pitch.

APPLICATIONS

The object of one typical check, on the column alignment of a gear hobbing machine, performed as shown in Fig. 3, is to determine whether the motion of the saddle is parallel with the axis of

rotation of the table. A reflection Rodolite N is used to define the line N-P, which is observed through a sighting head Q. This head, which is mounted on a bracket attached to the hob saddle, is provided with micrometer movements. When the table is rotated, the optical line N-P describes a hyperboloid of revolution about the axis R-S, of the table, as shown in Fig. 4. Since it is a cross-section of the hyperboloid, the path swept by the intersection of the optical line N-P with the sighting head is a circle.

Readings x and y are taken at 90-deg. intervals of table rotation, and the mean values, x and y then indicate the position of the axis of the table in relation to the saddle. These readings are taken with the table in motion, after the machine has been running for about 48 hours, and are repeated with the saddle in a series of different positions, z, on the column. Profiles of saddle motion, such as those shown in Fig. 5, are obtained by plotting x and y against z. Irregular variations of x and y indicate lack of straightness in the saddle motion, and linear variations, lack of parallelism between column and table-axis.

When the rotational axis of the table " wanders " during a revolution, the path swept by the image in the sighting head is not circular. Translational wander can be distinguished from tilting of the axis by examination of paths swept near to, and far away from the grating. If the axis is only moving translationally, the paths will be equally non-circular, whereas if the axis is tilting, they will not be of the same shape. Results obtained on a hobbing machine with a tilted table-axis are shown in Fig. 6, and those from a 150-in. hobbing machine, with departures from circularity of $\pm 0{\cdot}0001$ in., in Fig. 7.

To check whether the axis of the table wanders during a column-alignment check, a perpendicular section of the figure of revolution swept by the line is examined for deviations from the hyperbolic form. For this purpose, the radii of the circles swept by the Rodolite image, during the check for column alignment, are determined, and plotted against saddle position, z. Hobbing machines can also readily be checked with the Rodolite for cross wind of the vertical guideways, and pitch and yaw of the saddle.

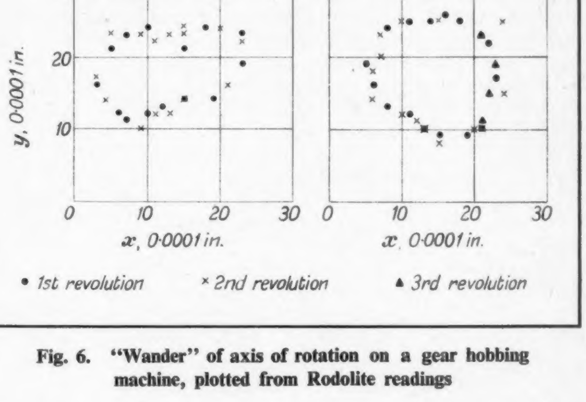


Fig. 6. "Wander" of axis of rotation on a gear hobbing machine, plotted from Rodolite readings

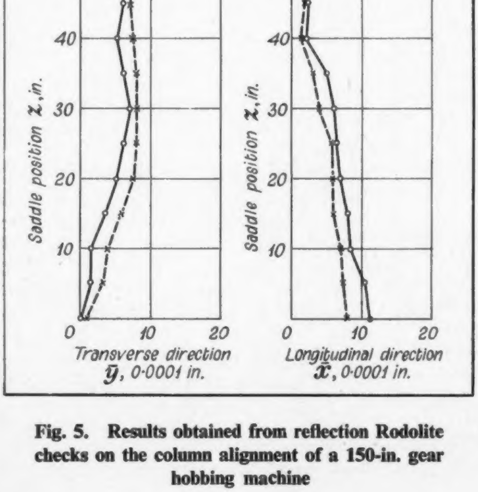


Fig. 5. Results obtained from reflection Rodolite checks on the column alignment of a 150-in. gear hobbing machine

HORIZONTAL GUIDEWAYS

The reflection Rodolite may be used to check the alignments of a wide variety of machine tools, and since gravity has no effect on the line defined, the first two checks described are equally suitable for machines with horizontal guideways, such as lathes and pinion hobbers. Cross wind and pitch of a saddle moving on horizontal guideways may be measured by using the mercury Rodolite as an optical plumb-line. Typically, for performing these checks on a lathe, the mercury pool and

grating are placed on the saddle, and the sighting head is held rigidly above the grating, on a bracket bolted to the saddle.

Yaw of saddles on horizontal ways cannot be easily measured with the mercury or reflection Rodolites. However, the reflection Rodolite can easily be converted to operate as an auto-collimator, by attaching a collimating lens to the sighting head and utilizing the zero-order beam diffracted by the grating, the latter then serving as a plane mirror. With the " mirror " attached to the saddle, and the sighting head telescope mounted on a fixed part of the machine, or *vice versa,* pitch and yaw may be measured directly, from the displacements of the image in the sighting head.

The following examples of total times for Rodolite checks are typical. Hobber, alignment, reflection Rodolite, 2 hours 45 min.; hobber, cross wind, mercury Rodolite, 1 hour 40 min.; lathe, cross wind and pitch, mercury Rodolite, 35 min.; pinion hobber, yaw and pitch, auto-collimating reflection Rodolite, 40 min. These figures, it may be noted, include both setting-up and measurement times, it being assumed that brackets for mounting the equipment already exist. It will be observed that the times are, in general, shorter than those for the methods of test in common use.

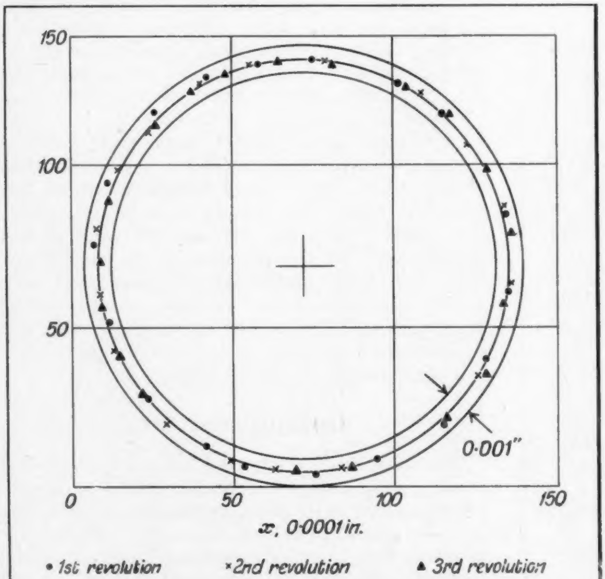


Fig. 7. Path swept by Rodolite image on 150-in. hobbing machine, showing departures from circularity of ± 0·0001 in.

The authors express their thanks to Dr. T. E. Allibone, C.B.E., F.R.S., Director of the Laboratory, for permission to present this paper.

ACKNOWLEDGEMENT

This abstract is published by courtesy of Pergamon Press, Ltd., publishers of the *International Journal of Machine Tool Design and Research,* the joint Editors-in-Chief of which are Prof. S. A. Tobias (Birmingham University) and Prof. F. Koenigsberger (Manchester College of Science and Technology). The papers presented at the Conference will subsequently be reproduced in full, in the above-mentioned Journal.

COBALT STRIP MATERIAL. Pure cobalt strip with good ductility can now be supplied by Sherritt Gordon Mines, Ltd., 25 King Street West, Toronto, 1, Canada, in thicknesses from 0·005-in. to 0·025-in. and widths from ¼-in. to 6 in. The strip is rolled from the company's cobalt powder by a new process, and is stated to be 99·9 per cent pure. Cobalt strip, cold rolled with a 4 : 1 reduction, has a tensile strength of 73 tons per sq. in., an elongation of 0·5 per cent and a Rockwell hardness (45T) of 85. In the annealed condition this strip has a tensile strength of 50 tons per sq. in., an elongation of 15 per cent, and a Rockwell hardness (45T) of 68.

There are two crystal forms for cobalt metal, namely, close-packed hexagonal at temperatures up to 417 deg. C., and face-centred cubic from this temperature up to the melting point. On cooling after heat-treatment at a temperature above 417 deg. C., a mixture of retained face-centred cubic and newly-formed hexagonal metal is obtained, which has improved ductility.

In the annealed condition, cobalt has important possibilities for applications where corrosion resistance and appreciable strength at elevated temperatures are required. It is twice as strong as nickel, retains this strength at higher temperatures, and has comparable corrosion resistance. In addition, cobalt has excellent magnetic properties which are retained to a higher Curie point than are those of nickel. One promising application of cobalt strip is for magnetic tape for computers.

Delapena Induction Hardening Installation for Shafts

Delapena & Son, Ltd., Tewkesbury Road, Cheltennam, Glos., have recently supplied to Vauxhall Motors, Ltd., the induction hardening installation shown in Fig. 1, for handling several components for the gearbox of the new series of Victor cars. It comprises a type E 15/25 radio-frequency generator, an automatic type HS-DW horizontal shaft hardening machine made by Fritz Dusseldorf, Freiburg, West Germany, and incorporating a Delapena type R 51 radio-frequency transformer, and a re-circulating unit for cooling water. Delapena & Son, Ltd., are the sole agents in Great Britain, the Commonwealth, the U.S.A., and Canada, and the whole of Europe excluding Germany, Austria, and Switzerland, for Fritz Dusseldorf, and the shaft hardening machine in question is stated to be the first of its type to be installed in a British factory.

The type E 15/25 induction heater is a standard valve-oscillator type radio-frequency generator which delivers power at a frequency of 350 kc./s., with a maximum continuous output of 15 kW. This equipment can be used as a 25-kW. installation for any duty cycle for which the heating period does not exceed three-fifths of the total cycle time, and each heating period, at 25 kW., is not longer than 3 min.

A steplessly variable output power control is provided which can be used for matching the power output to the work over a wide range during the heating period, and is said to offer particular advantages in connection with the heating of ferrous metals. The air-cooled oscillator valves are operated at powers considerably below their rated outputs so that they have a high factor of safety. The equipment is safeguarded by a number of devices, and additional safety switches are provided for operator protection.

The hardening machine will handle workpieces from 4 to 11·8 in. long, and from ⅝ to 2 in. diameter. It incorporates feed and traversing mechanisms, cooling and quench water systems, the radio-frequency transformer and work coil mounting, and the control system. A steel-framed cabinet with aluminium panels provides a support for the feed and traversing mechanisms, with a drainage tank below.

By means of the feed and traversing mechanisms, the shaft components are transferred from the magazine to the work station, passed through the inductor work coil and quench ring, and ejected from the machine. As may be seen in the close-up view, Fig. 2, the magazine takes the form of a sloping tray whereon workpieces are stacked automatically or by hand. The component at the lower edge of the tray rests against a stop at the side of a pair of rollers, as may be seen in Fig. 2. These rollers, which are of stainless steel, are carried in ball bearings at each end, and their axes are arranged parallel but are slightly inclined to the horizontal.

There is a small clearance between the rollers and the latter can be rotated in the same direction by means of an electric motor. Each roller is reduced in diameter over a short portion of its length and the gap so formed accommodates the work coil and spray quench ring. At the left-hand lower-end, the rollers are aligned with a V-section guide which receives the finished work-

Fig. 1. General view of the Delapena-Dusseldorf induction heating installation for gearbox components of the Vauxhall Victor motor car

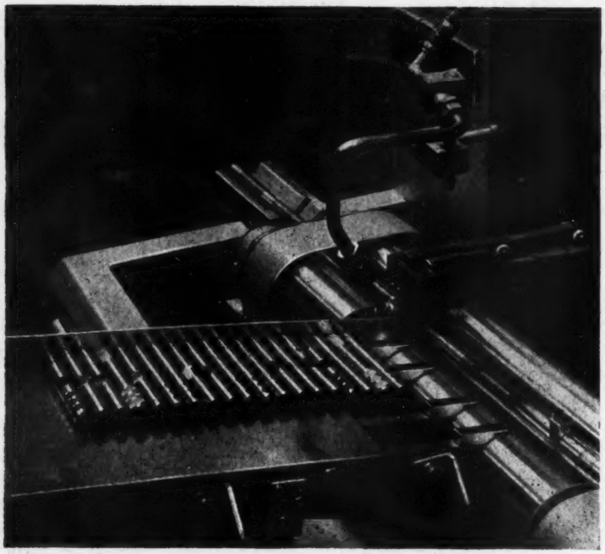


Fig. 2. Close-up view of the magazine and work station of the Delapena-Dusseldorf induction heating installation

pieces. A push rod is coupled to the piston of a hydraulic cylinder and extends parallel to and between the two rollers, at the right-hand-upper end.

Separate cooling and quenching water systems are provided with independent inlet and drain connections, stop valves, and pressure gauges. The cooling water circuit is further divided into two parallel branches for cooling the work coil and the secondary coil of the radio-frequency transformer. A separate stop valve in each circuit permits independent control of the two cooling flows, and allows the supply to the work coil to be shut off when the latter is to be changed. A pressure switch in each circuit shuts off the radio-frequency power if the cooling water supply fails, and a pilot lamp on the control panel affords an indication that the flow of cooling water through both circuits is adequate.

The Delapena type R 51 radio-frequency transformer is mounted on a platform in the upper part of the cabinet, with a work coil adapter bolted to the output terminals and projecting through an insulating panel. Provision is made for adjusting the platform in three planes so that the work coil can be positioned accurately in the gap between the rollers, with its axis aligned with that of the workpiece. The quenching spray ring is also fully adjustable.

Three work coils are provided to cover the range of five components at present being hardened on this equipment. All work coils are fitted with standardized mounting blocks to permit rapid removal from, and assembly with, the adapter.

Various controls provide for setting up and regulation of hardening cycles, as regards timing of the automatic feed, application of a variable rate of traverse for the workpiece, switching on and off the radio-frequency power, and control of the flow of cooling and quenching water. Safety arrangements include a switch which stops the machine when only one component is left in the magazine. The water re-circulating unit is of a standard Delapena type comprising a 60-gal. supply tank, water pump, radiator assembly, and cooling fan. Water is re-circulated through the induction heater and primary coil of the radio-frequency transformer at rates up to 2 gal. per min.

The component shown in the illustrations is a striking fork rod of En. 43B steel which requires to be hardened to a minimum of 51 Rockwell C. The diameter is 0·59 in., and the length 6·8 in., and the cycle time per piece is 21 sec. It is stipulated that the hardened area must not extend to the cross hole or the roots of the grooves.

NEW LEVELTRON INDUSTRIAL LEVEL CONTROLLER.—A new version of the well-known Leveltron industrial level controller has been introduced by Thomas Industrial Automation, Ltd., Station Buildings, Altrincham, Cheshire. Designated type CS101, the controller is for use with two electrode units, one mounted at the high level and the other at the low level position in a vessel, tank or other container. Only one controller is required for both high and low level control of pumps, conveyor motors, valves and similar equipment.

There is only one relay in the control unit, and it is de-energized when the stored material reaches the high level and is re-energized when the material falls below the low level, thus providing automatic interlocking between the two levels. The controller, which is housed in a sheet steel or cast iron case, can be used with any of the standard range of T.I.A. electrodes, and the maximum distance between the controller and electrodes is 50 ft.

7th European Machine Tool Exhibition, Brussels

Ninth Article

SCHIESS TYPE RFw 10 HORIZONTAL GEAR AND PINION HOBBING MACHINE

A general view of the German-built Schiess (Sykes Machine Tool Co., Ltd., The Hythe, Staines, Middx.) type RFw 10 precision horizontal gear and pinion hobbing machine is given in Fig. 1, where it is seen set up for operations on a single-helical gear. It will cut gears of plain spur, single-helical, or double-helical (by end milling) form, and will accept blanks up to 59 in. diameter. The maximum distance obtainable between the faceplate and the tailstock centre is 158 in., and the maximum face-width that can be cut is 112 in.

The faceplate is mounted directly on the headstock spindle, and the latter is driven through the master indexing worm and wormwheel, which has special provision for the elimination of backlash. A feature of the headstock is that the master worm and wheel can be disengaged and drive can be taken through a pinion and bull-ring behind the faceplate. This drive is employed for roughing operations on large-pitch gears, and relieves the worm and wheel of excessive duty which might affect its accuracy. The tailstock is a massive casting which is supported on flat ways on the front bed, and is adjusted for position longitudinally by means of a pinion which meshes with a rack in the throat of the bed. Twin steadies are provided on the front bed, to support the work at either side of the gear portion.

The hobbing head is swivel mounted on a heavy casting which is arranged for transverse movement on a saddle, and the latter has a longitudinal movement of 112 in. on the rear bed. A close-up view from the rear of the machine is given in Fig. 2, where the hobbing head, saddle, and rear bed can be clearly seen. The saddle slides on wide flat ways, and is traversed by a screw which is housed in a channel and is totally-immersed in oil. The associated nut is of the split type, and provision is made for adjustment to eliminate backlash. A swivelling movement of 45 deg. about a horizontal pivot is provided for the hobbing head, on either side of the central position, to enable right- and left-hand helical gears to be cut.

If required, spur and single-helical gears up to 85 module can be cut by the single-indexing process, an end-milling head being employed in place of a conventional hob. This operation can be carried out with a fully-automatic cycle, and the machine is switched off after a predetermined number of teeth has been cut. Another special attachment enables double-helical gears to be end-milled by the single-pass method. For this

Fig. 1. General view of the Schiess type RFw 10 precision horizontal gear and pinion hobbing machine

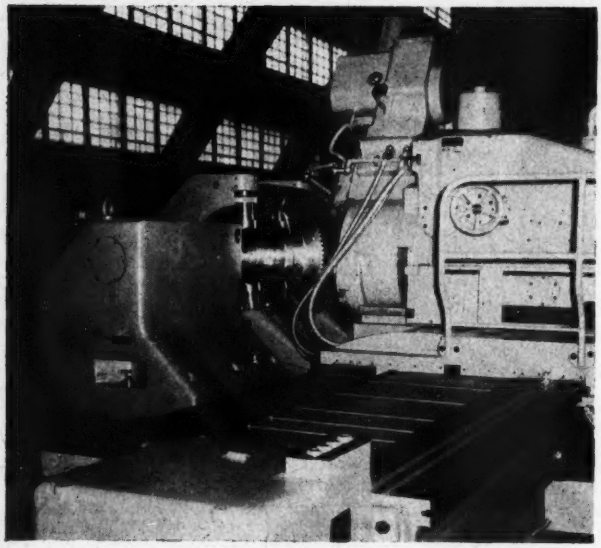


Fig. 2. Close-up view from the rear of the Schiess hobbing machine, showing the hobbing head and saddle

operation, the machine is provided with special reversing gear, whereby the direction of rotation of the work is automatically reversed when the apex of the double-helical tooth is reached. Longitudinal travel of the saddle is applied continuously, and it is stated that reversal of rotation is effected at the same point for each tooth within very close limits, so that the apices are in close alignment.

Conventional or climb-hobbing can be employed, and the drive to the hob spindle is transmitted through duplex worms, to eliminate backlash and to provide a balanced drive. It may be noted that gear teeth up to 30 module size can be cut in steel blanks when the faceplate is driven by the worm and wheel.

OERLIKON TYPE F 60 CHUCKING LATHE

The type F 60 chucking lathe shown in Fig. 3 has been introduced by Oerlikon Machine Tool Works, Buehrle & Co., Zurich, Switzerland (Dowding & Doll, Ltd., 346 Kensington High Street, London, W.14) and is provided with plug-type programme control. It is particularly intended for operations on such parts as gear blanks, hubs, and brake drums, in either small or large batches, and is provided with two tool-slides, each equipped for copying under the control of a hydraulic system. The slides are inclined at 30 deg. to the horizontal, to facilitate the discharge of swarf into a wheeled bin housed in an aperture provided in the welded steel bed.

A maximum diameter of $23\frac{5}{8}$ in. can be swung over the bed-ways, and $20\frac{7}{8}$ in. diameter over the tool-slides. Lengths up to $15\frac{3}{4}$ in. can be turned externally, and up to $7\frac{7}{8}$ in. internally, and the stroke of each copying slide is 9 in. Each copying slide base has a transverse traverse of 10 in. on its saddle, and can be swivelled up to 30 deg. on either side of a

Fig. 3. Oerlikon type F 60 open-ended chucking lathe, with plug-in programme control

central position. The spindle has a 6¾-in. diameter main bearing, an American standard A11 nose, and a through hole of 4$\frac{5}{16}$ in. diameter. Spindle speeds range from 22 to 500 r.p.m., in four groups, each divided into four steps, and changes of speed can be made while turning is in progress, and under the control of the programme control equipment. Alternative speed ranges, from 31 to 720, 45 to 1,000 or 63 to 1,400, can be provided, on request.

Longitudinal and transverse feed to the tool-slides is applied hydraulically, and the rates range from 0·002 to 0·040 in. per rev., and are steplessly-variable. There is also a rapid traverse rate of 20 ft. per min. for quick advance and withdrawal of the tools in the longitudinal and transverse directions. The movements of each saddle longitudinally are limited by slotted plates, which serve to carry adjustable dogs for actuating limit switches. Other dogs are employed to initiate changes in spindle speed, feed rate, and the engagement of rapid traverse, all in conjunction with the programme control system. The plates, complete with dogs, are readily removable, and can be stored until they are required for a repeat run.

Each copying slide has a 4-position tool turret, which is indexed by programme control, and slotted plates similar to those employed for longitudinal movements are provided for limiting the transverse motion. Flat sheet templates are used for the copying system, and provision is made for raising the templates, under programme control, so that the edges can be engaged successively by a stepped-nose copying stylus. With this arrangement, successive copying passes can be made from the same template, the stylus advancing slightly at the start of each pass so that roughing, semi-finishing, and finishing cuts can be taken. The programme provides for raising each template as many as six times, so that with a 6-step stylus, heavy metal removal can be spread over that number of passes.

Alternatively, several templates can be used, stacked one above the other, and the elevating motion is then employed to bring each plate successively into line with the copying stylus. Separate push-button and rotary switch control panels are provided adjacent to each saddle, and the programme control equipment, which is of the free-standing type, can be seen at the right in the figure.

BOHLE TAPE-CONTROLLED MILLING MACHINE

Reinhard Bohle, K.G., Bielefeld, Germany (Drummond-Asquith, Ltd., King Edward House, New Street, Birmingham, 2), build a wide range of milling machines, with table sizes from 40 by 12 to 98 by 25 in., and knee movements from 13¾ to 17¾ in. Machines in the standard range have 18 spindle speeds, in various groups from 11 to 560 to 35 to 1,800 r.p.m. according to size of machine and customers' requirements, also 27 feed rates for the longitudinal and transverse motions, from $\frac{5}{8}$ to 124 in. per min., and vertical feeds of one-third of these rates.

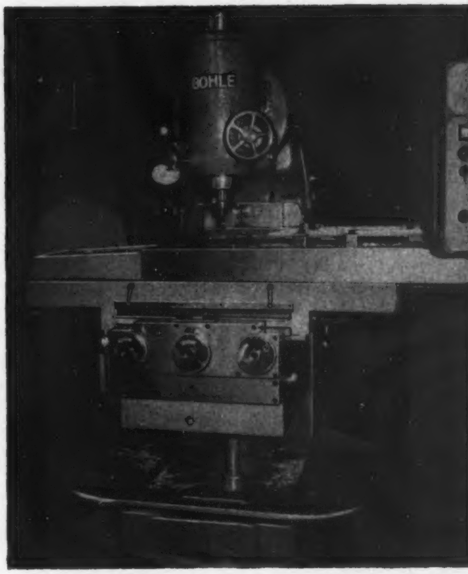


Fig. 4. Bohle type FS 120/1850 vertical milling machine adapted for 3-axis control by the AEG punched-tape system

Exhibits included a type FS 120/1850 vertical milling machine, from the standard range, which had been specially adapted for punched-tape control. Shown in Fig. 4, the machine has a 71- by 20-in. work-table with longitudinal and transverse movements of 49 and 17 in., and the vertical movement of the knee is 17 in. The spindle head is of the quill-type, with an axial adjustment of 4¾ in., and drive is taken from a 25-h.p. motor. On the machine illustrated, the spindle has a standard 50 series nose, but it can be provided with a No. 5 Morse taper as an alternative.

The normal drive arrangements for the three main machine movements have been replaced by servo-motors, which are controlled by punched-tape equipment developed by A.E.G., Hohenzollerndamm 150, Berkin-Grunewald, Germany. A close-up view of the combined control cabinet and tape-reader is shown in Fig. 5, and this unit is installed

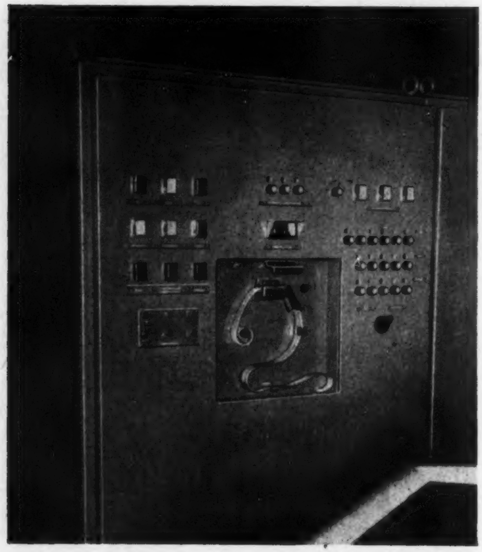


Fig. 5. Close-up view of the AEG combined control cabinet and punched-tape reader for the Bohle milling machine shown in Fig. 4

separately from the machine. Standard 8-channel paper tape is employed, and the reader is housed in a recess at the centre of the cabinet, and is covered by a plastics window.

To the right of the tape reader may be seen three horizontal rows of control knobs, which provide for setting dimensions in any of the three axes by hand, if the use of a punched-tape is not justified. The top row of knobs controls longitudinal movement, the centre row transverse movement, and the lower row vertical movement. Above each knob there is a small circular window, and the control is turned until the required digit appears. In this manner dimensions in any axis can be built up. The rotary switch below the dial-in knobs is of the 2-position type, and provides for selecting either automatic (punched-tape) or manual control.

It is hoped to describe the AEG tape control system in more detail in a future issue of MACHINERY

LINDNER TYPE LB 12 OPTICAL JIG BORING MACHINE

The type LB 12 optical jig boring machine shown in Fig. 6 has been introduced by Herbert Lindner G.m.b.H., Berlin-Wittenau, Germany (Stedall Machine Tool Co., 192 Pentonville Road, London, N.1), for operations on small jig and fixture parts, but is also suitable for small-batch production work, and can be employed for facing and milling operations. The working surface of the table measures 20 by 10 in., and it has longitudinal and transverse movements of 16 and 10 in. respectively. A vertical movement of 7¾ in. is provided for the spindle head, for initial setting purposes, and the boring spindle, which is of the quill-type, has an axial movement of 5 in. The distance from the centre of the spindle to the face of the column is 16 in., and the minimum and maximum distances obtainable from the nose of the spindle to the working surface of the table are 4 and 16¾ in.

Spindle speeds are steplessly-variable within the range from 60 to 3,000 r.p.m., and speeds from 420 to 3,000 r.p.m. are transmitted directly by way of a belt. For the lower end of the speed range, drive is taken through a gear train. Three rates of vertical feed are provided for the spindle, namely 0·001, 0·002 and 0·005 in. per rev., and depth settings are made with the aid of a dial indicator to an accuracy of 0·0005 in. The feed motion is automatically disengaged when the required depth has been reached.

The work-table moves on hardened and ground rollers in the longitudinal and transverse directions, and initial rapid setting for position is made by means of the two handwheels seen projecting

Fig. 6. The Lindner type LB 12 optical jig boring machine

from the front of the machine, at either side. For final setting there are two additional handwheels, mounted vertically at either side of the control panel. The latter is conveniently placed immediately in front of the operator, and is of the desk-type. It incorporates a number of push-buttons, for starting and stopping the spindle, increasing and decreasing the speed, engaging and disengaging the feed, and controlling the coolant pump. It also houses two projection screens, which are associated with the optical setting equipment for longitudinal and transverse movements of the table.

The optical system incorporated in the machine is similar to that employed on other Lindner jig-borers, and allows the table to be positioned to within 0·0001 in. There are two highly-polished stainless-steel cylinders, one attached to the table and the other to the cross-slide, and each cylinder has a finely-defined helical line engraved on the periphery. Provision is made for turning the cylinder about its longitudinal axis, but it is restrained from moving axially. By means of a lamp, and a system of mirrors, lenses, and prisms, an image of part of the helical line is projected on to a screen which is provided with two closely-pitched parallel lines. Separate screens are provided for the longitudinal and transverse movements.

After turning each cylinder so that the projected images are zeroed between the lines on the projection screens, initial setting of the table is made with the aid of conventional precision scales built into the machine, and graduated in increments of 0·10 in. The remainder of the required dimension is then set with the aid of a micrometer head, which is arranged to turn the appropriate engraved cylinder by the required amount about its longitudinal axis. As a result, the projected image of the helical line is displaced from between the two lines on the associated viewing screen, and it is then necessary only to move the table—by the fine-setting handwheel—until the image is again centralized between the two lines. A feature of the type LB 12 machine is that two additional sceens, one for the longitudinal and one for the transverse movement, are provided, whereon the distances which have been moved during the final setting stage are indicated directly, in whole numbers of 0·0001 in.

SCHNEIDER CREUSOT TYPE RUP 48 Y 4 SURFACE GRINDER

In Fig. 7 is shown the French-built Schneider Creusot type RUP 48 Y 4 surface grinder [Machine Tool Sales (London), Ltd., 79 Portland Place, London, W.1]. The 18- by 11¼-in. work-table has a maximum travel of 19¾ in. on vee and flat guideways, and steplessly-variable traversing speeds from 3·3 to 80 ft. per min. are provided hydraulically. There is no handwheel for longitudinal movement, but the table can be traversed slowly under the control of a separate lever, for example, for positioning when wheel dressing is to be carried out. A cross travel of 12¾ in. is provided for the saddle, which is guided by central and outer bed-ways, and feed can be applied continuously at rates ranging from 8 to 96 in. per min., or intermittently at the ends of the table movement. Lubricant is delivered to the central bed-way by a built-in pump, and to the other ways by means of rollers.

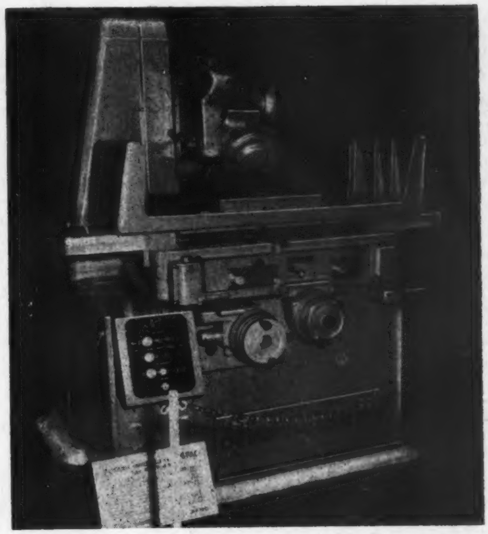


Fig. 7. French-built Schneider Creusot type RUP 48 Y 4 hydraulic surface grinder

Drive to the wheel spindle, which runs at 2,950 r.p.m., is taken from a 3-h.p. motor through a flexible coupling, and the bearings are lubricated by a built-in pump. The wheel-head can be swivelled on the saddle by a pinion and segment gear, and may be set in the horizontal or vertical position, or at any intermediate angle. It can be secured to the saddle in the required position, by means of a clamp, and is provided with a sine bar attachment to facilitate accurate setting for angle. Disc-shaped grinding wheels up to 8 in. diameter can be mounted on the spindle. Alternatively, a 6-in. diameter segment-type wheel may be

employed. Work up to 11¼ in. diameter high may be ground with a new disc-shaped wheel, and up to 9¼ in. high with a segment wheel. The hand-wheel for traversing the wheel-head saddle on the column ways can be set in two positions on its shaft to give coarse and fine adjustment, and provision can be made for down feed to be applied automatically, in increments ranging from 0·0002 to 0·0008 in. per table stroke. Alternatively, hydraulic equipment can be provided, which enables the wheel-head saddle to be continuously traversed on the column ways for a pre-set distance under the control of upper and lower stops.

MORANDO TYPE VK 25 VERTICAL TURNING AND BORING MILL

The type VK 25 turning and boring mill shown in Fig. 8 is representative of a range built by Fratellii Morando & Co., S.p.A., Turin, Italy (Industrial Sales, Ltd., 25 Barton Arcade, Manchester). With a 98-in. diameter work-table, it is the second largest machine in a range of seven, with work-tables from 36 to 118 in. diameter. Of the double-column type, it has two rail-mounted tool slides, the left-hand slide being arranged for copy-turning under the control of electrically- or hydraulically-operated equipment. Both rail heads are arranged for swivelling, through an angle of 35 deg. to either side of the central position, and each slide has a vertical travel of 39 in. The right-hand column only is provided with a side head, which has a vertical travel of 75 in. and a working stroke of 35 in.

A range of 16 feed rates is provided for all tool slides, in the vertical and transverse directions, from 0·0026 to 0·5 in. per rev. of the table, and the latter, which is driven by a 65-h.p. motor, normally has a speed range of 2 to 60 r.p.m. Alternative speed ranges for the table, of 2·5 to 75 or 1·5 to 45 r.p.m., can be provided if required. Speed changes are effected by sliding gears and clutches, which are actuated hydraulically, and the machine shown at the Exhibition was also equipped with an automatic speed variator, of an electrical type, to enable constant cutting speed to be maintained during facing operations.

The table is carried on a high-tensile iron spindle which is mounted in opposed taper-roller bearings, and drive is transmitted by a pinion which meshes with a large-diameter single-helical gear secured to a flange at the upper end. Oil for lubrication is delivered under pressure to the top bearing, whence is falls by gravity through the bottom bearing and returns to a sump in which the latter is immersed.

Power traverse at a rate of 14 in. per min. is provided for the cross-rail on the columns, and it can be raised to allow a 75-in. high workpiece to be machined by the rail heads. The rail is raised and lowered by twin screws, one at the side of each column, which are synchronized by a special coupling, and drive is taken from a motor mounted centrally on the tie bar which joins the tops of the columns. The rail is clamped hydraulically by a double-ended, twin-piston cylinder, which is also mounted on the tie bar. A piston rod extends from each end of this cylinder, and is provided with rack teeth which engage with a pinion carried on the top of a vertical shaft. The shaft serves to turn two pairs of eccentric type clamps, at the ends of the rail, to lock the latter to the columns.

Fig. 8. The Italian-built Morando type VK 25 turning and boring mill, which is representative of a range of machines

The copying head and stylus are carried at the end of a shaft which, in turn, is supported from a bracket on the left-hand tool-slide. Flat sheet templates are employed, of the type seen at the extreme left in the figure, and the copying head controls the feed

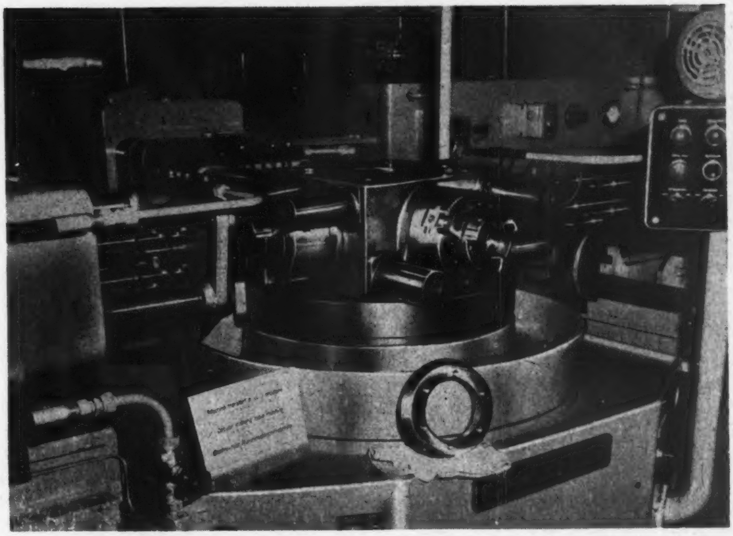


Fig. 9. Close-up view of a Bammesberger 3-head special-purpose machine for drilling, reaming, and tapping operations on blanks for bevel gears

motion of the tool-slide vertically and of the saddle transversely, by way of hydraulic motors. As mentioned earlier, electrically - operated copying equipment can be supplied if required.

Attachments available for use with this machine include a vertical grinding spindle, which is driven through belts by a separate motor, and has a stroke of approximately 16 in. Another, smaller grinding unit, in which the motor is integral with the spindle, is also available, and is particularly intended for operations on workpieces with small - diameter bores. Mention may also be made of a slotting attachment, which incorporates a striker mechanism whereby an increment of feed is applied to the tool at the end of each return stroke.

BAMMESBERGER SPECIAL-PURPOSE MACHINES

Examples of special-purpose high-production machines built by Bammesberger & Co., Stuttgart, Germany (Stanley Howard, Ltd., 73 Devon Street, Birmingham, 7), included the rotary type, of which a close-up view is shown in Fig. 9. This machine provides for drilling, chamfering, reaming, and tapping six equally-spaced holes in a blank for a bevel gear, and the output is 137 workpieces per hour at 80 per cent efficiency. A completed workpiece, as taken from the machine, is seen resting on the base in the foreground.

The indexing work-table carries a large rectangular block at its centre, from each side face of which projects a 3-jaw, self-centring, hydraulically-operated chuck. The jaws engage the bore of the blank, and there is a steel block at the inner end of each which serves to locate the blank axially. Loading and unloading take place at the chuck position in the foreground, and the first indexing movement of the table carries the work to the multi-spindle head seen at the left. Here, six 8·5-mm. diameter holes are drilled and chamfered with combination tools, which are steadied in a bush plate in the conventional manner. This plate incorporates diagonally-arranged locating plungers which engage with bushes that are carried in supports projecting from the work-holding block.

At the next indexing movement the work is carried to the second multi-spindle head, which is identical in design to the first, and provides for reaming the holes to 9 mm. diameter. Finally, the holes are tapped to 10 mm. diameter by 1-mm. pitch by spiral-flute taps in the third head, at the right. The machine is of the electro-hydraulic type and the cycle is fully-automatic, the operator being required only to load and unload the work.

A more complex rotary-type machine, which has five working stations and a 7-position indexing table, is shown close-up in Fig. 10, and provides for multiple milling, drilling, and spherical boring operations on end pieces for swivel joints. At *A* in the figure can be seen a blank, and, at the left, a workpiece in the finished condition as it leaves the machine. The blank takes the form of a solid sphere with a reduced-diameter parallel projecting portion, and batches are fed at random into a vibratory-type hopper, a portion of which can be seen at the extreme left in the figure. From this hopper, the blanks pass down the inclined tube *B*, having been automatically sorted so that they proceed ball-end first, and a hydraulically-operated

shuttle mechanism removes the leading workpiece and loads it, ball-end uppermost, into a fixture.

There are seven identical work-holding fixtures on the table, one of which can be seen clearly at the centre in the figure. There are two opposed V-jaws, arranged for horizontal movement towards and away from each other, which grip the work by the spherical portion, and the lower part of each jaw has a part cylindrical groove to engage the shank.

At the first working station there is a column-mounted head *C*, arranged for vertical movement, and this head carries two slitting saws, as at *D*. These saws machine two parallel flats on the spherical portion of the workpiece, the part-spherical waste material falling away into a tray below the table. The distance between these flats is slightly greater than the diameter of the parallel boss on the blank, also slightly greater than the thickness of the jaws in the fixture.

At the next station, a parallel hole is drilled through the spherical portion, at right angles to the flats, and at the following station this hole is spherically bored by a special swivel-mounted tool. The head at the fourth station incorporates a long over-arm, which extends over the fixture and carries a milling cutter that approaches the workpiece from the side nearer the centre of the table. This arm is indicated at *E* and it carries a short horizontal milling spindle and an axially adjustable steady bracket which provides support immediately behind the cutter. The latter finish mills the inner flat on the spherical portion of the workpiece, and opens out the short length of parallel hole which remains after the spherical boring operation.

The fifth head performs similar milling and opening-out operations on the other side of the work, and the final indexing movement brings the piece to the unloading position. Here, the fixture jaws are opened and the work falls into a delivery chute. To obviate the possibility of the work failing to fall clear under its own weight, a double-acting hydraulic ram *F* is provided, which is automatically energized to advance and knock the work from the jaws. This machine has an output of 120 parts per hour, at 80 per cent efficiency.

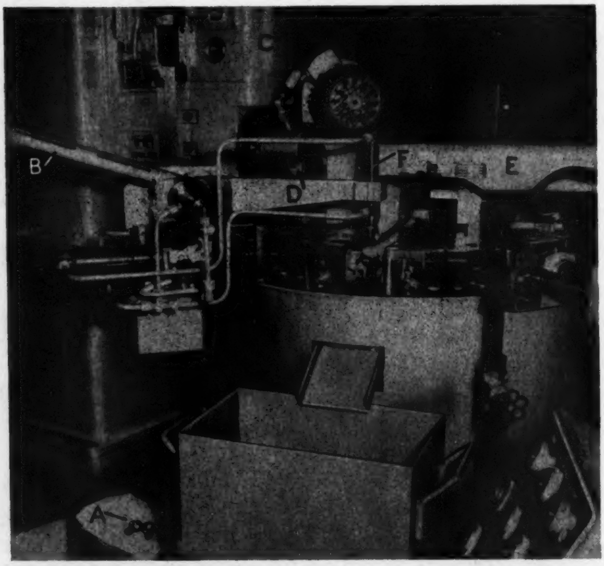


Fig. 10. This Bammesberger machine performs multiple milling, drilling, and spherical boring operations on end pieces for swivel joints

DE BUYSER CRANKSHAFT GRINDING MACHINE

The type C/225-75 crankshaft grinding machine shown in Fig. 11 is typical of the range built by J. De Buyser, 118-122 Rue des Coteaux, Brussels, Belgium (Scot Urquhart, 373a Earlsfield Road, London, S.W.18). With these machines, main journals and crankpins can be ground, also the blending radii between the bearing surfaces and the webs, with the shaft in the vertical position. The lower end is supported in a special chuck on a power driven table, and the upper end is steadied by a centre in a bracket which extends from the cast-iron column. With this arrangement, it is claimed, the crankshaft is free from the deflecting and torsional forces which would be imposed by its weight if it were mounted horizontally.

There are guides on the column for a saddle, which can be traversed vertically and serves to support the grinding head. The latter is mounted with its spindle horizontal, and grinding is carried out with a cup wheel. Drive to the spindle is taken through belts from a motor mounted on the saddle, and there is provision for longitudinal movement of the spindle head, for setting the face of the wheel to the required distance from the centre of the bearing to be ground. The chuck which holds the lower end of the shaft is arranged for radial adjustment, relative to the centre of the table, and on the machine illustrated it can be set to

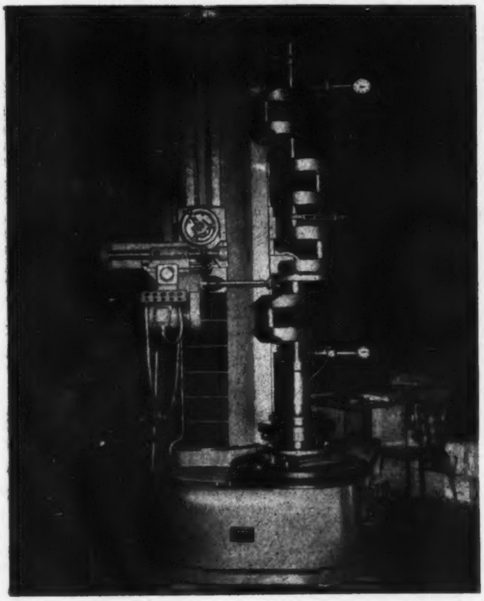


Fig. 11. De Buyser crankshaft grinding machine

suit crankshafts with throws up to 6½ in. Shafts up to 118 in. long can be handled, and can be driven at speeds between 5 and 28 r.p.m.

For dressing the wheel, a special bracket which carries a diamond is clamped to a convenient journal on the shaft. The latter is held stationary and the spindle head is raised and lowered, to pass the wheel across the diamond.

E.R.O.P. MICROBANC SURFACE GRINDER

The Microbanc type HP 37 surface grinder shown in Fig. 12 has been introduced by E.R.O.P., 71-73 Rue de Colombie (Seine), France, and has a 27½ by 11 13/16 in. work-table. It is of the hydraulic type, and the rate of longitudinal traverse of the table can be varied steplessly between 0 and 82 ft. per min. Movement can also be imparted manually, and in addition to a graduated collar and vernier for setting purposes there is an optical system which enables readings to be made to 0·002 in.

In the transverse direction, a powered movement of 13 in. is provided, and the optical equipment enables settings to be made manually to 0·00008 in. There is provision for setting to a similar accuracy in the vertical direction, and the grinding wheel head has a rise and fall of 16½ in. For vertical traverse, the speed is 9 in. per min., and the maximum distance obtainable between a new 10-in. diameter grinding wheel and the surface of the table is 14½ in.

A wide range of automatic grinding cycles can be set with the controls provided. For example, the wheel can be lowered into contact with the work and a setting for a predetermined amount of metal removal can be made by means of the controls for the vertical movement. On pressing the start button, the table will continue to reciprocate, and the head to feed down, until the pre-set amount of metal has been removed. The grinding head is then returned automatically and rapidly to the raised position.

Settings can also be made to enable grooves or slots to be ground to pre-set depths, and to pre-set positions transversely. The head automatically feeds transversely to a dead stop, whereupon the cycle is started and incremental down feed is applied automatically at the end of each stroke. The wheel is thus progressively fed into the work, and the cycle continuues until the required depth is reached. A number of different types of grinding heads is available for use with the machine, including universal and vertical designs.

Another machine, with a 19¾- by 11 13/16-in. work-table, designated the type HP 35, is also produced, but does not have the same range of automatic cycles as the type HP 37.

Fig. 12. E.R.O.P. Microbanc type HP 37 surface grinder, which is provided with optical setting equipment. A range of automatic cycles can be obtained

Making the New Borg-Warner Automatic Transmission

Operations on Pressure Die Cast Aluminium Valve Block Castings

By R. E. GREEN, Associate Editor

THE NEW BORG-WARNER AUTOMATIC TRANSMISSION was briefly described, and reference was made to methods employed in the production of certain of its components in articles published in MACHINERY, 99/764—4/10/61, 99/888—18/10/61 and 99/1236—29/11/61. In the latter article, the preliminary operations on the largest of several pressure die cast aluminium alloy valve body components were described, up to the point at which the six valve bores are finish-reamed. Here, the remaining operations on this largest casting are considered, also some of the methods employed for machining another casting which forms part of the valve block assembly.

Some indication of the intricacy of the cored channels in the large valve body casting, which serve as oil-transfer passages in the completed assembly, is afforded by the heading illustration. Here, the operator is engaged in chamfering drilled holes and removing burrs from the channel edges and surfaces with the aid of a Desoutter air-operated drill gun and other hand tools. The complete removal of loose material, which might become detached in service and cause sticking of valve plungers or other troubles in the hydraulic system, is extremely important. Special brushes, of soft nickel-silver wire, to avoid scratching finished surfaces, are employed for thorough cleaning. These brushes are of stepped form, and about $\frac{1}{16}$ in. larger in diameter than the bores to be cleaned.

FINISHING THE JOINT FACES

After the manual cleaning operations, the castings are washed in a water-soluble emulsion and transferred to the British-built Thompson (Rockwell Machine Tool Co., Ltd.) bed-type surface grinding machine shown in Fig. 1. This machine is employed for finishing flat side faces on both the larger castings for the assembly, simultaneously, and is equipped with a simple fixture on which two large and four smaller castings are held in vertical positions. Location of the castings is taken from drill-reamed holes which are engaged with dowels projecting from the vertical faces of the fixture, and they are secured by floating pads, clamping force being applied by lever-operated cams.

The positions in which the castings are thus held ensure that all the side faces are in line, and can be ground with a single wheel, 3 in. wide and of 20 in. diameter when new. The wheel, which is of WA 46 KV specification, is dressed by means of the diamond in a bracket at the front of the ram guideways. On the two larger castings it is the side face, in which there are two valve bores, that is ground. Two of the smaller castings are loaded one way up, and the other two with the opposite faces upwards. Some 0·007/0·008 in. of material is removed from the faces, and they are required to be flat within 0·001 in. total indicator reading after this operation. It may be noted that this grinding operation on the faces of the smaller castings is performed towards the end of the machining sequence.

FLAT-HONING OPERATIONS

The large joint face on the main valve body casting is next honed flat within 0·0003 in. all over on the type 844-1 Microflat (A. A. Jones & Shipman,

Fig. 1. With this set-up, on a British-built Thompson bed-type surface grinding machine, side faces on valve body castings of two sizes are finished simultaneously

Ltd.) machine shown in Fig. 2. This machine is also employed for similar flat-honing operations on several other castings incorporated in the valve block assembly. The horizontal honing wheel has an outside diameter of 40 in. and a face width of 7 in., and is mounted at the top of a spindle which is driven at a speed of 40 r.p.m. A transmission system is provided for driving a shaft above the wheel, which carries a steel spider.

In the spaces between the arms of this spider there are steel plates with apertures having outlines similar to those of the castings to be finished. These castings are placed in the apertures in the loading position at the front, so that the joint face of each rests on the wheel. The spider is rotated at about 1 r.p.m., in the same direction as the wheel, and it is also oscillated through an arc about the axis of the supporting pillar. The extent of this oscillation is controlled by the setting of an eccentric pin relative to the centre of a vertical driven shaft in a projection at the rear of the arm. This pin engages with a slot in a bracket secured to the pillar. The oscillating motion, at 10 strokes per min., causes the parts to move across the wheel as they turn.

The spider carries a number of brackets in which cranked levers are pivoted. The ends of these levers project above the plate apertures and carry projecting pins, which are arranged so that they bear on flat surfaces on

Fig. 2. The final operations on the joint faces of the aluminium alloy castings employed in the hydraulic valve block are carried out on this Microflat flat honing machine

Fig. 3. Joint faces on valve body castings are inspected for flatness, which must be within 0·0003 in., on this granite surface plate. Movement of an air-gauging head at the table centre are indicated on the manometer tube, which is graduated in 0·0001-in. divisions

the castings. Weights on the arms serve to hold the castings in close contact with the wheel surface. At the inner end, each lever has a roller, and above these rollers there is a cam secured to the quill whereby the spider can be raised and lowered.

As each lever approaches the front of the machine, the roller comes into contact with a rise on the cam, with the result that the inner end is pushed down, and the weight is lifted from the casting, which can then be removed and replaced by another. Normally, one circuit of the plate, occupying about 1 min., is sufficient to remove some 0·002/0·0025 in. from the joint face and to bring the surface within the required limits for flatness. Limits on surface finish are also imposed, the maximum depth of scratch permissible being 32 micro-inches. During honing, a mixture of mineral oils, specially compounded for the purpose to a Micromatic specification, is flooded over the wheel and passed through a filter unit seen in the background in Fig. 2.

When flatness errors on the finished work exceed the limit of 0·0003 in. mentioned above, the wheel is dressed by means of the air-operated attachment seen in the right foreground in Fig. 2. This unit incorporates two housings connected by parallel cylindrical guide-bars, one housing being pivoted on a bracket at the side of the machine. The other has a hole for a vertical pin which can be engaged with a bore in a hinged post at the centre of the wheel spindle. This post is raised for the wheel dressing operation and serves to support the housing at such a height that

Fig. 4. Equipment supplied by the Vernon Instrument Co., Ltd., is employed for checking the diameters and concentricity of the stepped valve bores in the two larger castings for the valve block assembly

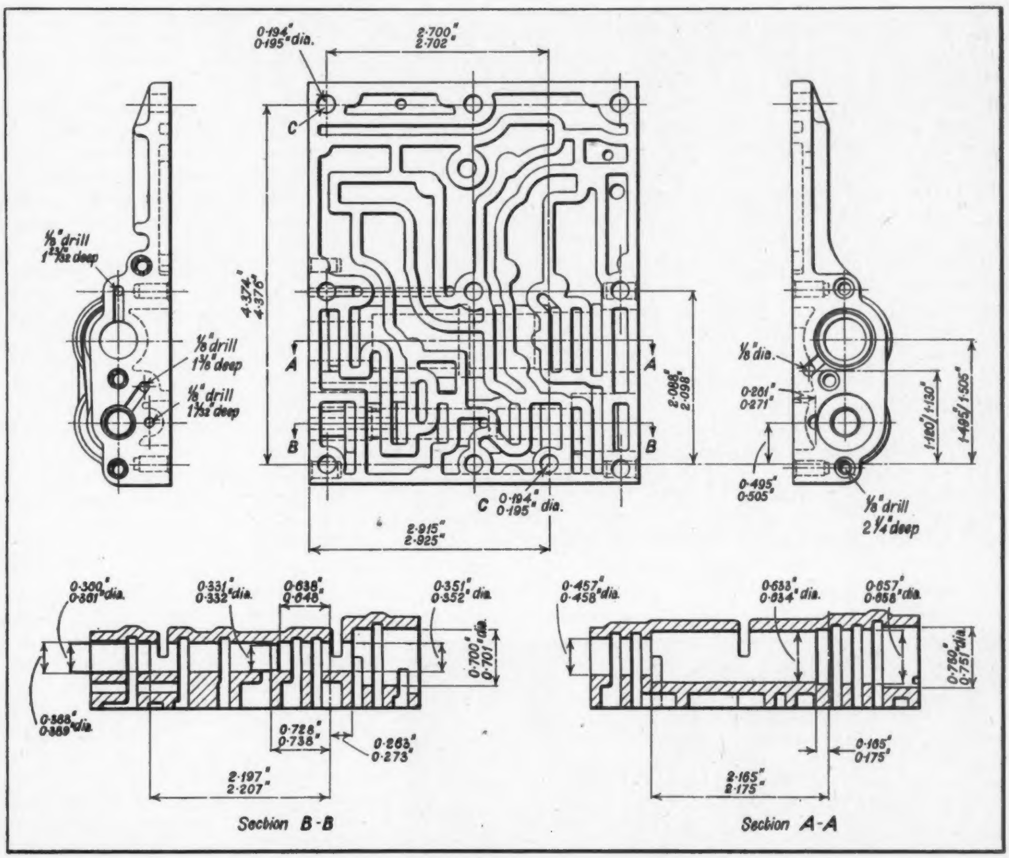


Fig. 5. The upper valve body, which is here shown in plan, end elevation and section, has two stepped bores to house the valve plungers

the guide bars are in a horizontal plane. A carriage on the bars, in which the dressing diamond is mounted, can be moved at any desired rate by means of an air cylinder at the outer end of the attachment, the speed of traverse being controlled by a hydraulic check cylinder alongside.

Considerable thought was given to the method to be employed for inspecting the flatness of the finished surfaces and the simple equipment developed is seen in Fig. 3. This equipment includes a granite surface plate supplied by Windley Bros., Ltd., in which a central hole is drilled. In the hole is fitted an air gauging head of the axial plunger type, with the plunger end projecting slightly above the surface. The head is connected to the single tube of a Vernon manometer unit at the right, the scale of which is graduated in divisions of 0·0001 in. When the casting is laid flat on the plate and moved over the mushroom-headed plunger, variations in flatness are indicated by movements of the liquid in the tube.

At the final operation on the large casting, the finished surfaces are power brushed to remove any burrs thrown up at the edges of the valve bores during grinding or honing. This work is performed on an old Kent-Owens horizontal milling machine, the spindle of which is fitted with Tampico or bristle brushes, and the castings are then washed, and dried with air jets, in a Dawson type B, automatic unit.

Inspection of the bore diameters in both the

large and the smaller castings is carried out with the Vernon equipment shown in Fig. 4. A separate gauging head is provided for each bore in both castings, and these heads are of the mechanical contact type to avoid difficulties that may arise if air jets are used in long bores of small diameter and blind bores. Movement of the contacts serves to vary the size of an air jet within the body of the gauge, and this variation affects the height of the liquid in one of the manometer tubes shown. Ring gauges, of the nominal diameters of the bores, are provided for setting purposes and are housed in recesses in a cabinet provided for the gauging heads. The scales of the manometer tubes are graduated in 0·0001 in. divisions. Separate equipment is employed for checking the concentricity of the stepped bores on a sample basis.

OPERATIONS ON UPPER VALVE BODIES

The series of operations on the upper valve body, which is shown in plan, end elevation, and section in Fig. 5, is somewhat similar to that performed on the larger casting, and starts with machining of the flat joint face. Two location holes *C*, Fig. 5, are then drill-reamed, after which the castings are returned to the first machine, and the side faces are milled. The set-up on this Heald type 221, single-ended, fine-facing machine is shown in Fig. 6, and the castings are loaded at the rear position of the fixture, as seen at *D*, for the first operation. Location is taken from the ends of the cored valve bores at *A-A* and *B-B*, Fig. 5, which are engaged with two spring-loaded tapered dowels projecting from housings beneath the casting.

Support against the cutting pressure is provided by a pivoted beam *E*, with a pad at each end. This beam is pivoted on a horizontal, spring-loaded plunger, which can be locked in position by a knurled screw, after the casting has been loaded. The plunger is normally adjusted only for a fresh batch of castings. Behind the casting there is a vertically-moving slide on the fixture, which is actuated by a horizontal air cylinder at the top, through a cam, and this slide carries two tapered dowels which are engaged with the upper ends of the valve bores when it is moved down.

After the facing and drill-reaming operations have been carried out, two castings are loaded, with opposite side faces towards the cutters, in the fixture at the front in Fig. 6. Here, the castings are dowel-located on opposite faces of a parallel-sided support member, to which they are secured by lever-type clamps as seen in the foreground. Each clamp carries a pivoted beam with pads whereby pressure is applied to the rear face of a casting, and when they are released the clamps are drawn together at their right-hand ends by a tension spring. The ram of an air cylinder at the right (not shown) carries a double wedge which is moved into position between the right-hand ends of the levers, to bring the beam pads into contact with the castings, when the air cylinder is energized by means of a push-button.

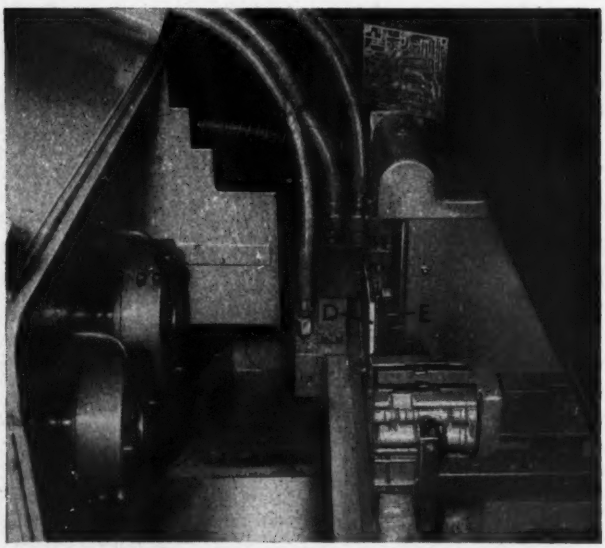


Fig. 6. The large joint face and the two end faces are milled on this Heald type 221 single-ended machine at one set-up. After the large joint face has been milled, dowel holes are drill-reamed before the castings are loaded in the vertical positions for milling the end faces

For machining the casting faces, pairs of single-point tools, made from solid Ardoloy carbide, are set in the cutter bodies on a pitch circle of 6·5 in. diameter. The spindles are run at 1,300 r.p.m., and the table is fed up to a stop, to bring the work into engagement with the tools, and is then traversed at 11 in. per min. for the facing operation. A finished casting is seen on top of the clamping air cylinder in Fig. 6.

A 6-station Mulhead rotary indexing machine is next employed for drilling and tapping all three faces machined at the previous operation. A close-up view of the tooling is given in Fig. 7, and it will be seen that the table carries two pairs of fixtures. In the fixture at the left, which is duplicated at the opposite side of the table, the casting is held in a horizontal position, joint face upwards, on a work-plate. This plate rests on a carriage which is arranged to slide horizontally, on two cylindrical bars, to move the work to and from the clamping position.

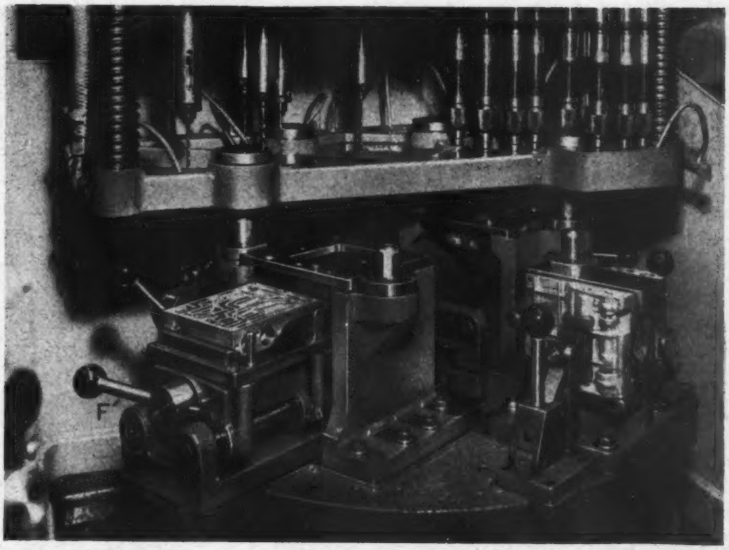


Fig. 7. Various holes are drilled and tapped in all three machined faces of the upper valve body casting on this 6-station Mulhead machine. Two pairs of fixtures are mounted on the table

When the plate is advanced, the casting is positioned beneath the fixed bush-plate and is raised by a cam mounted on the end of a shaft which is turned by means of the ball-ended lever *F*. Pegs and supporting projections on the work-plate provide for approximate location, and the drill-reamed holes engage locating dowels provided on the under-side of the bush-plate as the casting is raised into the clamping position.

On the other two fixtures, one of which is seen at the right in Fig. 7, the castings are again dowel-located, with opposite faces upwards, on a parallel-sided support member, to which they are secured by substantial toggle-type clamps. It will be noted that these latter fixtures are positioned near the table edge, and that the other two are located near the centre.

At the first machining station there is a single spindle which operates on the left-hand of the two vertically mounted castings, to drill a ⅛-in. diameter hole. There are three spindles at the second station, and one hole is drilled in each of the vertical castings and one in the horizontal casting. At the third position there are two spindles which drill one hole in the horizontal and one in the left-hand vertical casting. Six holes, some of which are cored, are tapped in the two end faces at station four, and six more holes are tapped in the horizontal face, at station five.

Holes of ⅛ in. diameter by 1·719 and 2·25 in. deep are then drilled in the two end faces of the casting, to form oil transfer ports, on a Hüller duplex pillar machine. Two simple fixtures with swinging clamps hold the castings side by side on this machine. A Pollard No. 21A drill is then employed to rough and semi-finish ream the bores at *A-A* and *B-B* in Fig. 5. Subsequently, the castings are washed before these bores are finish-reamed on a Heald type 222, double-ended, fine-boring machine. The set-up and the tooling are similar to those employed for the bores of the larger casting, as described in the previous article, and the bores are then brush-deburred before the castings are loaded on the fixture of the Thompson machine in Fig. 1, for grinding the end faces.

Flat-honing of the large joint face follows, on the Microflat machine, after which the finished faces are brushed on the Kent-Owens machine. The castings are finally washed, dried in an air blast, and inspected.

GRINDING, HONING AND LAPPING MACHINES to the value of £2,621,512 were exported during the period up to September 30 this year, which was an increase of £667,180 as compared with the value of similar machines exported in the same period of the previous year.

N

Osromatic Vibratory Finishing Machines

The latest addition to the mechanical finishing equipment built by Roto-Finish, Ltd., 39 Park Street, London, W.1, is a range of Osromatic vibratory finishing machines for metal and plastics parts. Each of these machines is equipped with an English Electric vibratory motor, of foot-mounted design, which is bolted directly to the under-side of the work-container. With this motor, it may be noted, vibratory action is obtained by means of matched pairs of out-of-balance weights, which are mounted close to the ends of the rotor shaft. One weight in each pair can be adjusted angularly, for altering the amplitude of the motion from $\frac{1}{32}$ to ¼ in., and the shaft, which is of suitably large diameter, runs at a speed of 1,500 r.p.m. in roller bearings. The work-container, which is lined with abrasion-resistant rubber, is of U-section fabricated steel construction, and is mounted on four compression springs.

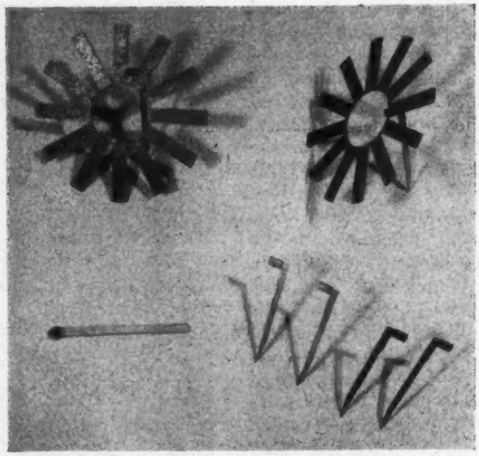


Fig. 2. A batch of about 7,000, 0·015-in. thick laminations, as seen in the upper part of this illustration, was de-scaled and de-burred in a cycle time of 20 min. The needles for textile machines, seen below, were de-burred and polished without rounding of the points. The parts are shown before and after vibratory finishing

Fig. 1. Of these die-cast components seen before and after processing by vibratory finishing, the toy motor cars were de-flashed and the surfaces improved, for painting, in a 45-min. cycle. The remaining items were "cut down" and polished, for plating, in separate stages which occupied 4 and 2 hours

Media are similar to those employed with barrelling equipment, and due to the vibratory motion, relative movement occurs between the medium and the work, combined with rotation of the entire mass within the container. Various advantages claimed for the process have been discussed in recent articles in MACHINERY, and some typical die-cast components are shown in the "before" and "after" conditions in Fig. 1. Attention is also drawn to the delicate components shown in Fig. 2, which afford an indication of the type of work which can be finished without damage by this process.

In operation, liquid compound is continuously sprayed on to the work-load from a distributor pipe, which is mounted above the container and extends for the full length. After passing through the load, the fluid drains from two outlets in the bottom of the container, and is collected in a storage tank, whence it is re-circulated by a motor-driven pump. With this system, which is the subject of a patent, metal particles are continuously removed from the load, and allowed to settle in the tank, and it is claimed, in consequence, that there is no need to wash the components after unloading. Moreover, the fluid can be used for successive operations over a period of some days, with substantial economies.

The range includes the types OV. 1, OV. 3, OV. 7, and OV. 10 machines, which occupy floor spaces measuring from 2 ft. 4½ in. by 2 ft. 4 in. up to 7 ft. 5 in. by 5 ft. 7 in. and the work-container on each machine has a capacity corresponding to the numeral in the designation, in cu. ft. Average loads for the smallest and the largest sizes in the range include 25 and 225 lb. of components. If required, provision can be made on the two largest units for the use of fixtures, for holding large work-pieces, and on each machine, the container is carried by a sub-frame, which is horizontally pivoted and is swung through an arc of 120 deg.

Fig. 3. To facilitate unloading, the work-container assembly of the Osromatic type OV. machine is tipped forward by an air-operated system, and the load is here being discharged from a 7 cu. ft. capacity unit

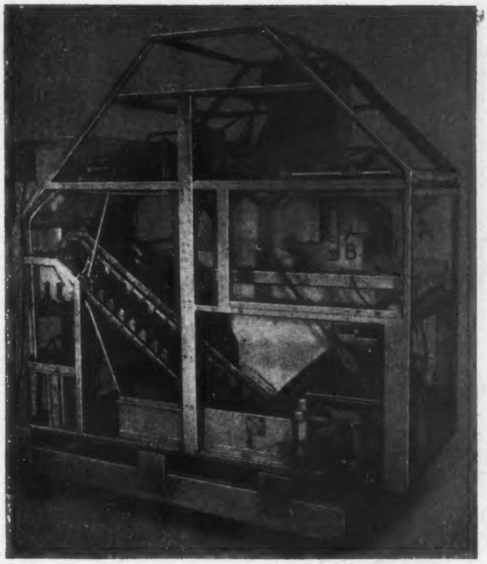


Fig. 4. A recently-built batch-type automatic vibratory finishing machine is here shown without the enclosing covers

towards the front, by means of a push-button controlled air-operated system, for unloading. Such an operation is seen in progress on the type OV. 7 machine in Fig. 3. Doors at the front and the top of the cabinet, whereby access is gained for loading and unloading, complete enclosure of the working area, and all the interior surfaces are faced with a sound-deadening material.

There is also a 10-cu. ft. capacity machine of simpler design, in which the container is carried by the main frame, and cannot be tipped. A door at one end is opened for unloading, to allow the charge to fall on to a chute, and to assist the flow, the container can be vibrated for short periods under the control of an " inching " push-button. On the type OV. 10 and the end-unloading machines, the compound tanks have capacities of 110 and 50 gal., respectively, and as an indication of the power requirements, it may be noted that the vibrator motor on each of these machines is rated at 4 h.p. The control equipment incorporates a process timer, for stopping the motor at the end of a pre-set period.

Since the work-container does not rotate, the process may readily be adapted for automatic operation, and in Fig. 4 is seen an automatic machine which the company has recently built, for

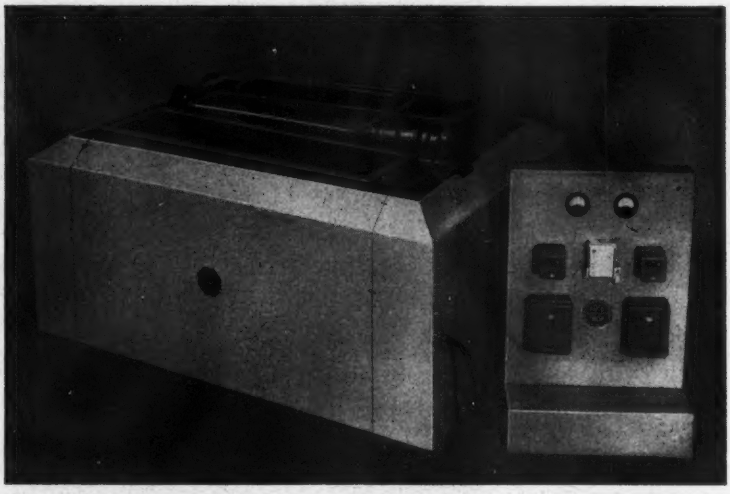


Fig. 5. Work in connection with the development of vibratory finishing equipment for continuous operation is being carried out by Roto-Finish, Ltd., with the aid of this twin-container machine

installation in a factory in Southern England. For purposes of illustration, the covers whereby this machine is almost totally enclosed have been removed. At the beginning of each working cycle, the loading skip *A*, which is carried by pivoted arms, is swung upwards, to discharge a batch of components into the work-container *B*, which has been previously charged with the medium. After the skip has returned to the original position, the vibrator motor is started, for processing for a predetermined period, up to 4 hours, under the control of a timer, and simultaneously, the pump which provides for circulating the compound is automatically brought into operation.

Following the processing stage, the motors are stopped and the container is tipped, to discharge the work-load into a hopper. The container is subsequently returned to the original position, and from the hopper, the medium and the components are fed on to the inclined bucket conveyor seen in the foreground. Water is sprayed from distribution pipes above this conveyor, for rinsing, and from the upper end of the run, the medium and the components are discharged on to a lateral vibratory conveyor. At the end of the latter, the components are removed by a magnetic separator, and transferred to a discharge chute, and the medium is passed to a steeply-inclined bucket conveyor at the rear, whence it is returned to the container in readiness for the next cycle. The separator, also the drive motors for the conveyors and the pump in the rinsing system, are started when the container is emptied, and the period for which they run is controlled by a separate timer.

Work in connection with the development of equipment for continuous operation is being carried out with the machine shown in Fig. 5, on which there are two work-containers, arranged side-by-side and inclined in opposite directions. Advantage is taken of the rotary movement of the work-load and by means of vanes, it is caused to travel slowly towards the lower ends of the containers. The load is transferred from each container to the upper end of the other by means of lateral vibratory conveyors, associated with one of which there may be a separating unit, for removing the components. Individual compound systems are provided for the containers, and with this arrangement, the workpieces may be passed successively through two processing stages, for de-burring and polishing, for example.

Philips Variable Transformers with Dust Protecting Enclosures are now available, so that these units need no longer be mounted outside dust-laden areas, even when the atmosphere contains abrasive or corrosive dust. It is claimed that no de-rating of the transformers is necessary when the new enclosures are provided, unless the ambient temperature exceeds approximately 25 deg. C. Enclosures, which are of welded construction, from steel sheet, and finished in grey "hammered" stove enamel, are available for all sizes of transformers, except the 20-amp. type. If it is required to isolate the transformer from the supply when the cover is removed, a single-pole plunger switch, which is operated by the cover, is fitted.

The sole distributors for Philips variable transformers in the U.K. are Research & Control Instruments, Ltd., 207 King's Cross Road, London, W.C.1.

M.T.T.A. Design Course Awards

Certificates to mark the successful completion of the 2-year course in machine tool design and technology instituted by the Machine Tool Trades Association, were presented to the first group of nine students at the Grand Hotel, Manchester, on December 1. It may be recalled that the introduction of this course was announced by the M.T.T.A. in 1959, and that studies are pursued at Manchester College of Science and Technology (which now forms part of the University of Manchester), under the direction of Dr. F. Koenigsberger, Professor of Machine Tool Engineering. The course is of post-graduate standard, and is intended for young men in the machine tool industry who have already shown aptitude for design. A scholarship scheme on a generous scale, with an admission rate of ten students annually, has been established by the M.T.T.A., and this scheme has now entered its third year.

Nine certificates were awarded on this occasion to recipients who have already returned to industry. In addition a special prize of 25 guineas was given to Mr. Brian Hodgson (William Asquith, Ltd.), who was the outstanding student of the group. The other recipients were Mr. J. R. Earnshaw (Snow & Co., Ltd.), Mr. H. C. Fletcher (James Archdale & Co., Ltd.), Mr. R. G. Francis (Alfred Herbert, Ltd.), Mr. R. H. H. Hartley (James Archdale & Co., Ltd.), Mr. D. Horobin (B.S.A. Tools, Ltd.), Mr. D. S. T. Nunney (James Archdale & Co., Ltd.), Mr. A. Shaw (William Asquith, Ltd.) and Mr. T. D. Yarwood (H. W. Kearns & Co., Ltd.).

The presentation was attended by Dr. B. V. Bowden, principal of the Manchester College of Science and Technology, Dr. W. Johnson, head of the Department of Mechanical Engineering, and Dr. Koenigsberger. In introducing Mr. R. D. G. Ryder, past-president of the M.T.T.A. and managing director of Thos. Ryder & Son, Ltd., the chairman, Mr. C. A. Sparkes, director of H. W. Kearns & Co., Ltd., apologized for the absence of Mr. J. C. Snow, president of the M.T.T.A., who had had to attend a meeting of the F.B.I. Export Council for Europe.

Mr. Ryder expressed his own pleasure in deputizing for Mr. Snow, and mentioned that he had been closely associated with the scholarship scheme from its inception. He pointed out that although the machine tool industry, like all others, had its faults and deficiencies, it offered a challenging career, with real opportunities for progress and responsibility. Some four years ago, it was felt that design and development based solely on experience and practical judgment would not suffice, and that there was a need for engineers who could tackle new problems analytically, with the background of a systematic study of technological principles, and with the aid of the tools of mathematics and engineering science. It was considered that there were many able and possibly brilliant young engineers among the design staffs of the industry who would benefit from study at a university college with specialized knowledge, interest, and experience of machine tools. The M.T.T.A. scholarships were the result of happy and fruitful co-operation—not for the first time—between the machine tool industry and the Manchester College of Science and Technology, which was thought to provide the finest education in the country in the particular subjects required.

Continuing, Mr. Ryder expressed the thanks of the Association to Dr. Bowden, Dr. Johnson, Dr. Koenigsberger, and their staff for their foresight in meeting the needs of the students, their elegant treatment of the course, and their enthusiasm. He pointed out that sacrifices had been made by the college in providing the necessary facilities, by the employers of the students who had lost the services of some of their best young designers for two years, and by the students and their families due to intensive study, separation, and dislocation of family life.

A brief reply to Mr. Ryder was made by Mr. Brian Hodgson on behalf of the recipients of certificates, in which he expressed thanks to the M.T.T.A. for the opportunity for advanced study which had been made available.

It may be of interest to give some details concerning the course in machine tool technology and design. All M.T.T.A. scholarship holders are treated as a group, and the first year is devoted to the more academic aspects, including lectures and laboratory work relating to performance requirements, design specifications, and basic design and calculations for machine tools; electrical engineering and electronics; hydraulics; vibration; friction and lubrication; control engineering; properties and behaviour of engineering materials; standardization; metrology; ergonomics; safety regulations; automation; and kindred subjects.

During the second year of the course, the students are sub-divided into smaller groups for work on a design project. The subjects are chosen to ensure that the members of each group are concerned with machine tools outside their previous experience, and that each member carries out work on some new aspect of design. For example, a

student previously concerned with milling machines may be allocated to a group engaged in the design of a gear grinding machine, and if his previous work has been related to gearboxes, he may be made responsible for the design of the main structure. During this second year, lectures are given by machine tool specialists from a range of firms in the industry, and students have the opportunity of discussing, and obtaining advice on, any particular aspects of the design they are undertaking. When completed, the design has to be defended by the students against the criticisms of a committee.

Students are also given certain tasks to perform in connection with the research projects undertaken by the college. During the two long vacations, it is arranged for each sudent to work with a company engaged in the building of machine tools different from those made by his own firm, first, in this country, and then abroad.

Journal of Production Research

The first issue of the *International Journal of Production Research* has recently been published by The Institution of Production Engineers, 10 Chesterfield Street, London, W.1. The Journal will be issued quarterly in English, French and German, and Professor N. A. Dudley, Ph.D., Department of Engineering Production, University of Birmingham, has been appointed editor, and Dr. S. Corlett, Department of Engineering Production, University of Birmingham, and Dr. S. Eilon, Imperial College of Science and Technology, London, associate editors. In addition, a panel of consulting editors has been appointed, representing Australia, India, Norway, Spain, Sweden, Switzerland, the U.K., the U.S.A., and West Germany.

In the editorial in the first issue, Prof. Dudley has explained that the journal is primarily intended " to provide a vehicle for the publications of those university and other research workers whose primary interest is in advancing the science of production, and for whom, until now, there has been no single and appropriate journal." Papers and reports prepared by university and industrial research personnel will be published in the journal which will cover all aspects of production in a variety of technologies, for the guidance of others engaged in research, also lecturers at universities and colleges. For example, it is hoped that ergonomists will submit papers for publication on the performance characteristics of workpeople, to assist those engaged in operational research who are frequently required to make assumptions of such performance, also on the nature of human control systems which it may be of advantage to simulate for the design of automatic control arrangements. Moreover, it is hoped that research reports will be received for publication on the psychological and sociological, as well as the economic and technical aspects of production.

In the first issue, papers are presented by authors in this country, the U.S.A. and Australia, under the headings:—two inventory control models; an electrical analogue for solving transportation problems; selective assembly—its analysis and applications; research in machining high strength materials at elevated temperatures; a note on a method of estimating the precision of time study observations; estimation of service requirements for production purposes; and optimal revision periods.

The Editorial Committee of the Institution is responsible for the administration of the journal, and correspondence relating to subscriptions should be addressed to:—Miss M. S. C. Bremner, International Journal of Production Research, 10 Chesterfield Street, Mayfair, London, W.1.

Supports for Measuring Standards

In MACHINERY, 99/944—25/10/61, an article was published describing the new SIP type CLP-10 photo-electric comparator, and details were given of the means whereby a line standard to be checked is supported at the Bessel points. Enquiries have been received requesting more detailed information on Bessel points, and it may be of interest therefore to consider the various supporting systems which are set out in Vol. XXI of *Les Travaux et Memoires de Bureau International des Poids et Mesures*, Sèvres, Paris, France.

BESSEL POINTS.—Supports at these points are employed when checking line standards, since they ensure the minimum shortening of overall length. The supports are usually cylindrical, and their centres are calculated from the formula $d = 0{\cdot}5594\ L$, where L = the total length of the standard and d = the centre distance of the supports.

AIRY POINTS.—Supports at these points are used for checking end standards, since they ensure that the tangents to the curves at the extremities of the standard are horizontal. As a result, the defining ends of the standard are vertical and parallel. The formula is $d = 0{\cdot}5774\ L$.

It may also be noted that the formula $d = 0{\cdot}5537\ L$ gives the centres of supports that ensure the minimum deflection. Such supports are not normally used for standards work, but are of value in machine tool design, where it is necessary to minimize the curvature of a slideway, for example.

Finally, supports placed at centres calculated from the expression $d = 0{\cdot}5505\ L$ will ensure that the tangents to the curves immediately above the support points are horizontal.

NEWS OF THE INDUSTRY

Manchester and District

B. & S. MASSEY, LTD., Openshaw, Manchester, 11, report an increasing flow of orders for their range of drop hammers, and forging and trimming presses. Because of long experience in this field (this year marks the centenary), the company has been requested to act in a consultant capacity by a number of drop-forging concerns abroad. A large proportion of the output is exported, and current orders include several from overseas, including India and Yugoslavia, for the supply of complete forging plants.

CROSSLEY BROTHERS, LTD., Crossley Works, Openshaw, Manchester, 11, are still busy with the manufacture of the range of diesel engines for which they are well known. The company exports a high percentage of the production. Marine engine orders have recently been completed for Holland, Poland, Finland, the Persian Gulf, Hong Kong and several Commonwealth countries. Stationary engines recently built have included units for India and Ghana. Among orders lately executed for the home market were some for the supply of engines for use in connection with atomic power-stations.

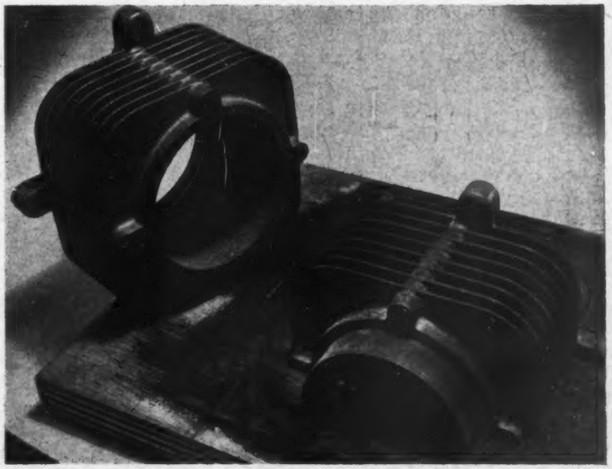
The general engineering department of the company is busy on contract work, and customers are taking advantage of all the services offered by the department, which include machining, fabrication, assembly work, and a foundry in which casting in Meehanite up to 20 tons can be produced. A recent development within the Crossley Group is the acquisition of Furnival & Co., Ltd., who specialize in the production of guillotines for the printing industry. All the plant and facilities have been transferred to the Reddish factory of the Group.

FRY'S METAL FOUNDRIES, LTD., Hargreaves Street, Manchester, 4, operate a branch foundry for the Group and specialize in the refining of tin and lead alloys from which solder in ingot and stick forms, and printing metals are made. The branch, it is stated, is fully occupied in meeting the demand. Associated products produced elsewhere in the Group are also stocked, and include fluxes, wire-type solder, and printer's melting equipment.

WILLIAM E. CARY, LTD., Redbank, Manchester, 4, are well-known for road springs for motor vehicles and associated equipment such as suspension components, and are suppliers to most of the leading vehicle manufacturers, as well as various public transport undertakings.

The Laminaire system of suspension which the company introduced three years ago is becoming increasingly popular, both as original equipment and for replacement. With this system, it is

The foundry pattern here illustrated, for rotary compressor unit bodies for Cooper-Stewart Engineering Co., Ltd., Letchworth, Herts., was recently cast in Araldite epoxy resin by J. Hobkirk, Sons & Co., Ltd., Bedford. A considerable saving in time was achieved by the use of this material instead of casting the pattern in aluminium, owing to the reduction in the amount of finishing required. In addition, it is stated, Araldite has much better wearing properties than aluminium.



claimed, constant ride characteristics are obtained, whether a vehicle is unladen or fully loaded.

Full production is also being maintained in the company's forge, and forks, which are supplied to most of the leading fork-lift truck manufacturers, account for a large proportion of the work in progress. Forks weighing up to 4 cwt. each are made, as well as comparatively small sizes. The press shop, which has equipment of capacities up to 1,000 tons, is busy on a wide variety of pressings, and a contract for the production of railway plates, and rail chairs, has just been completed. In the fabrication shop, cabs and lifting arms for earth-moving equipment are being manufactured.

Sheet metal work is undertaken by another department, and whereas work of a general nature is occupying some of the capacity, the section specializes in producing cable trunking, for which a steadily increasing demand is reported. Other products of the company include agricultural and industrial conveyors, which are marketed by their associates, Cary-White, Ltd., and for this equipment also, it is stated, there is a satisfactory call.

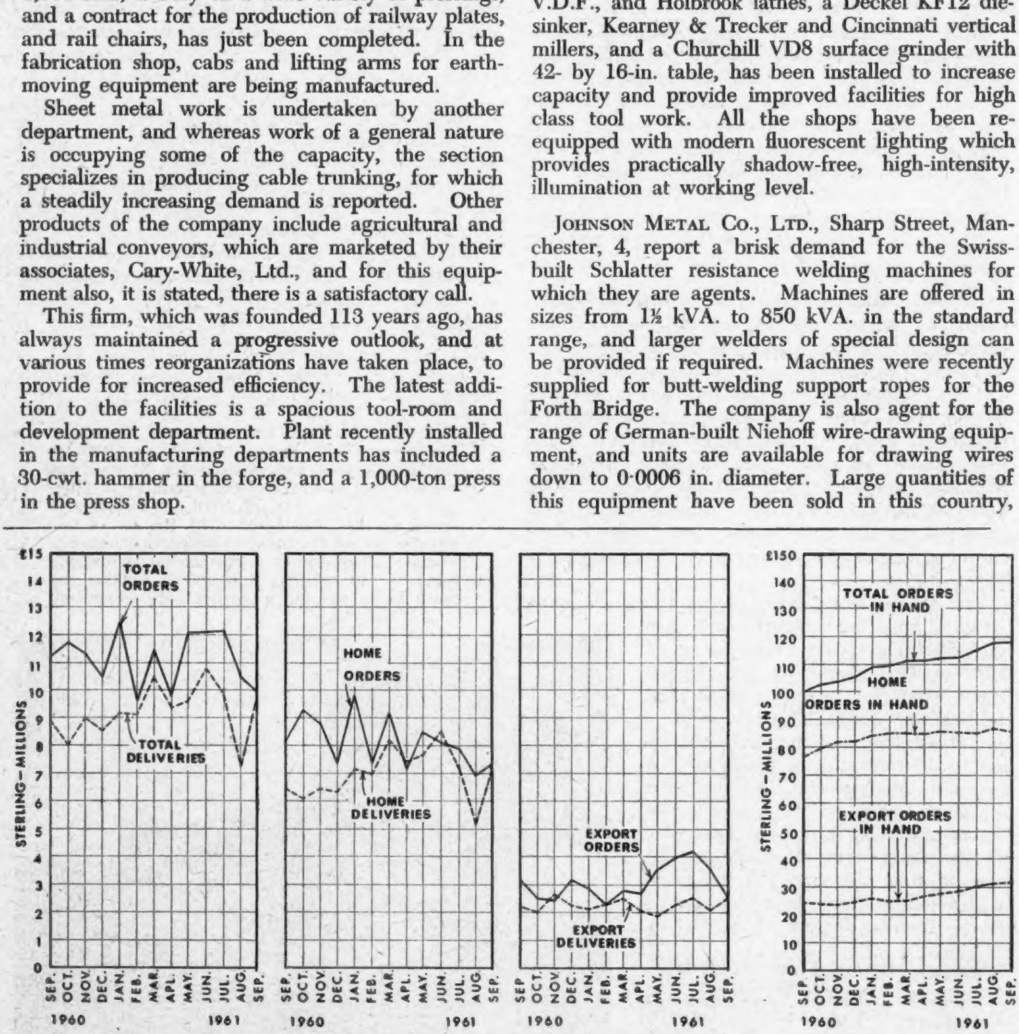
This firm, which was founded 113 years ago, has always maintained a progressive outlook, and at various times reorganizations have taken place, to provide for increased efficiency. The latest addition to the facilities is a spacious tool-room and development department. Plant recently installed in the manufacturing departments has included a 30-cwt. hammer in the forge, and a 1,000-ton press in the press shop.

G.P.A. Tools & Gauges, Ltd., Harper Road, Wythenshawe, report that they have a well-filled order book covering press tools, jigs, fixtures, plastics moulds, precision components, and special equipment.

Re-organization over the past 18 months has made it possible to accept a greater volume of work and maintain satisfactory deliveries.

Considerable new plant, which includes Lang, V.D.F., and Holbrook lathes, a Deckel KF12 die-sinker, Kearney & Trecker and Cincinnati vertical millers, and a Churchill VD8 surface grinder with 42- by 16-in. table, has been installed to increase capacity and provide improved facilities for high class tool work. All the shops have been re-equipped with modern fluorescent lighting which provides practically shadow-free, high-intensity, illumination at working level.

Johnson Metal Co., Ltd., Sharp Street, Manchester, 4, report a brisk demand for the Swiss-built Schlatter resistance welding machines for which they are agents. Machines are offered in sizes from 1½ kVA. to 850 kVA. in the standard range, and larger welders of special design can be provided if required. Machines were recently supplied for butt-welding support ropes for the Forth Bridge. The company is also agent for the range of German-built Niehoff wire-drawing equipment, and units are available for drawing wires down to 0·0006 in. diameter. Large quantities of this equipment have been sold in this country,



The above graphs show the values of machine tool orders and deliveries for the twelve months ended September 1961, also the values of orders in hand

much of it to the leading cable manufacturers. Other items marketed by the company include tungsten carbide and diamond drawing dies, also machines for polishing these materials.

J. J. MARKLEW.

The South

INDUSTRIAL IMPREGNATIONS, LTD., Poyle Trading Estate, Colnbrook, Bucks., are now established in recently built works situated at a short distance from their original premises. With a floor area of 12,000 sq. ft., the new factory affords improved facilities for the impregnation of porous castings with polyester resin. Work in progress at the time of our visit included the impregnation of motor vehicle oil pump bodies, sumps for diesel engines, supercharger casings, food machinery parts, machine tool castings, crankcases for 6-cylinder diesel engines for railway traction purposes, and a variety of parts for Government Departments.

It is now customary for many firms to send all castings of certain types, for example engine crankcases, for impregnation, to ensure that any porosity, either apparent or undetected, is sealed. Castings are impregnated in a fully machined condition and after this process do not require any further treatment before use. Threaded holes and machined cavities, it is stated, are left free from residue on completion of the impregnating cycle, and treatment can be undertaken, by arrangement, as an emergency service. An autoclave of 6 ft. diameter by 7 ft. 6 in. deep enables large parts to be treated.

This company has established a new factory for the impregnation of castings in Sparkbrook, Birmingham, and similar services are shortly to be provided in Milan, Italy; Calcutta, India; and Buenos Aires, Argentina.

BEANSTALK SHELVING, LTD., Industrial Estate, Chichester, Sussex, have a good order book for a wide range of wire products which find numerous applications in industry. A recent addition to the Beanstalk series of wire trays is the Stacko-Rack which is available at present in two sizes. These trays are designed for stacking, and can be nested when empty, the erected height then being reduced by about two-thirds. A stack of the larger type has a maximum load capacity of 600 lb. and for the smaller size the corresponding capacity is 360 lb.

It is reported that a firm is using Stacko-Rack containers to transport scissors between different processing stations in a factory. The scissors are suspended in the mesh openings which are of similar dimensions for each container, and a ready and accurate means of checking batch contents is thus afforded, without tedious counting. An additional benefit is the avoidance of damage to the scissors through repeated handling. The extra hanging space for long-bladed scissors has been provided by modifying the rest bars, to enable alternate trays in a stack to be inverted.

A good demand is reported for Beanstalk Jacko-Rack 3-tier and 4-tier trolleys with heavy-duty wheels. The wire trays are provided with removable separators which enable compartments of different sizes to be formed, as may be required for transporting mixed batches of parts in stores and workshops.

W. E. SYKES, LTD., Staines, Middlesex, are still very busy with orders for machine tools for gear production and we are informed that there is a sustained demand for V 10 B vertical gear generators; also for Sykomatic vertical machines, which are widely employed for the quantity production of internal and external gears. Sykes machines are installed in many motor car factories in this country and other parts of the world, and we may note that an important vehicle manufacturing firm has incorporated one of the universal gear finishing machines in an automatic link line.

SYKES MACHINE TOOL CO., LTD., Staines Middlesex, are experiencing a satisfactory call for various special purpose and standard machine tools. The demand for heavy-duty lathes is well maintained and growing interest is reported in Boehringer machine tools. In this connection we may note that two crankshaft lathes of this make have been ordered by a well known company in this country.

F. W. HERRIDGE.

Research and Productivity Exhibition

An Industrial Research and Productivity Exhibition is to be held at Bingley Hall, Birmingham, from 10 a.m. to 6 p.m. daily, from May 23 to 31, 1962, under the sponsorship of the Birmingham Productivity Association, and it was recently announced that some three-quarters of the space allocated for display purposes had already been booked.

So far, D.S.I.R. and four other research organizations, also 14 well-known industrial firms from the Midlands and other areas, have agreed to participate in this exhibition, which is intended to focus attention on the work of research laboratories and the advantages to be gained by employing modern production techniques.

The largest display will be staged by the West Midlands Gas Board, and will draw attention to some of the applications of town gas in a number of industries and for different forms of heat treatment.

Conferences on various subjects, to be announced later, and industrial film shows will be arranged,

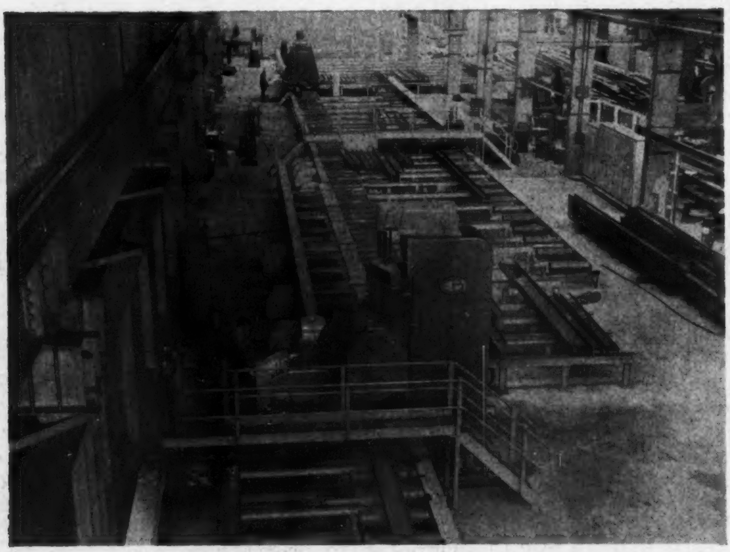
and it is anticipated that parties from the works of many of the 200 member firms of the Birmingham Productivity Association will visit the exhibition. Organized visits by students from colleges and grammar schools will be encouraged, and in this connection it may be noted that on a number of stands attention will be drawn to the training facilities available to young people embarking on industrial careers.

Applications for the remaining stands and stand sites in the exhibition building may be made by firms operating in the Midlands and elsewhere to W. G. Appleyard, 71 Broad Street, Birmingham, 15 (telephone, Midland 8073), who is organizing the exhibition on behalf of the B.P.A.

Boulton & Paul Fabricating Plants

The accompanying illustration gives a general view of a mechanized fabricating plant for structural steel which has recently been supplied by Boulton & Paul, Ltd., Riverside Works, Norwich, and installed in the London works of the subsidiary Moreland Hayne & Co., Ltd. In the foreground is seen the vertical saw supplied by Clifton & Baird, Ltd., behind it, to the right, the Archdale 12-spindle horizontal drill for flange holes, and in the background, the 6-spindle vertical drill for web holes, also by Archdale.

Boulton & Paul, Ltd., have also recently completed a plant of this type for export to Australia. This plant is destined for the South Melbourne works of Johns & Waygood, and has been specially designed to meet that company's requirement. Costing approximately £100,000, it occupies a floor area of about 21,000 sq. ft., and the complex system of powered conveyors and transfer benches is controlled from three push-button stations. The 13th to be built by the company since it was decided to offer such equipment for sale in 1955, this latest plant has a capacity for sawing and drilling steel sections up to 36½ in. by 50 ft.



Mechanized structural steel fabricating plant supplied by Boulton & Paul, Ltd., to their subsidiary, Moreland Hayne & Co., Ltd.

Exporting to Western Germany

Information concerning the export of British products to Western Germany was given by four German marketing experts at a recent London conference, which was arranged by the London School of Marketing, Ltd., Newspaper House, Great New Street, E.C.4.

Attention was drawn to some similarities in the British and German economies. It was pointed out, for instance, that there were inflationary tendencies in both countries, and shortages of skilled labour. At present, some 500,000 vacancies existed in German industry, which operated on a basic 44-hour working week.

On the subject of advertising, it was stated that some 85 per cent was accounted for by newspapers and periodicals, and that the remaining 15 per cent was divided almost equally between television, commercial radio, and posters. A speaker emphasized that advertisements for British goods should quote metric measurements, and that prices should be given in German currency. Attention was drawn to the importance of studying the German market carefully, and it was explained that it was inadequate merely to translate sales literature and advertisements.

In connection with the legal aspects of selling in Germany, a German lawyer explained some differences between German and British commercial law.

Eclipse Tool Department Extension

To provide additional space and machine capacity for the Engineers' Tool Department of James Neill & Co. (Sheffield), Ltd., to enable the increasing demand for tools in the Eclipse range to be met, a new 4-storey block has recently been brought into use at the company's Napier Street, Sheffield, premises, which has increased the floor area available to the Department by 44 per cent. This new block has been erected on the site of a single-storey building, which housed the material stores and the heavy milling and heat treatment sections, and alterations to previously existing buildings have been carried out.

In the new block, the various floors are served by a lift system of ample capacity, and incoming raw material, such as castings, and steel bar, sheet and strip, is received and stored in a section on the ground floor, where provision is made for accommodating the largest road transport vehicle. Also on the ground floor there is a machine shop, in which are installed single- and 6-spindle automatics, a large number of capstan lathes, and heavy vertical milling machines and shapers. Other machine shops are situated on the first and second floors, the second-floor shop, a general view of which is given in Fig. 1, being equipped for light secondary operations such as milling, shaping, turning, drilling, and tapping. The heat treatment section, on the third floor, is seen in Fig. 2, and it may be noted that the furnaces have pyrometric temperature control, and that hardness testing equipment is provided. Complete tools are assembled on this floor, and are tested and finally inspected, before being packed for despatch to the company's warehouse.

The flow of work in progress is controlled by way

Fig. 1 (above). General view of the light machine shop, on the third floor of a new 4-storey block, which has been provided for the Engineers' Tool Department of James Neill & Co. (Sheffield), Ltd.

Fig. 2 (left). The heat treatment shop on the third floor of the new block

of a store on the second floor, in which a stock of finished components is held for issue to the assembly section, and the planning office is situated on this floor. There are other offices on the first floor, together with a general store and the maintenance and cutter grinding sections.

Particular attention has been paid to working conditions, and the block is spacious and well-lighted. Heating is provided by a temperature-controlled system, and in the heat treatment section, there is a fume extraction system.

Industrial Notes

Burflex, Ltd., 7 Canal Street, Brierley Hill, Staffs. (telephone 77136) will undertake the regrinding of carbide burrs of a wide range of shapes and of any make. Normally, it is stated, the burrs can be reground and returned in a few days.

George Cohen Sons & Co., Ltd., inform us that their Engineers' Tool Department has been moved to the machine tool headquarters at 23-25 Sunbeam Road, London, N.W.10 (telephone, ELGar 7222). A large stock of tools and fine measuring equipment is carried, and the counter service will be continued at the new address.

J. A. Crabtree & Co., Ltd., Lincoln Works, Walsall, Staffs., recently opened new showrooms at 230 Tottenham Court Road, London, W.1, where examples of the company's Closegang and other wiring accessories, including 13 amp. socket-outlets, and type C-50 circuit breakers, are on view, also lighting fittings by C. M. Churchouse, Ltd.

Herbert Hunt & Sons, Ltd., Elsinore Road, Old Trafford, Manchester, recently received an order for three reamer flute milling machines from the Morse Twist Drill and Machine Co., Mass., U.S.A. Based on the company's standard designs, these machines will be modified to suit the customer's requirements.

The British Industrial Truck Association, York Mansion, 94-98 Petty France, London, S.W.1, are offering to the winner of their annual competition a place at the 9th Material Handling Training Course to be held at Lake Placid, U.S.A., in June, 1962. The closing date for the competition is March 15, and particulars and application forms can be obtained from the above address.

The Midland Electric Installation Co., Ltd., Cyprus Works, Upper Villiers Street, Wolverhampton, recently announced that further development work is now in progress in connection with their range of Hotfoil flat element heating tapes. It is planned to introduce flame-proof types, also tapes for temperatures up to 1,000 deg. C. Silicone rubber impregnated tapes suitable for heating to temperatures up to 250 deg. C. are already available.

Rapid Delivery of Grinding Machine to France.—To obtain an order in competition with a stock delivery machine, Burton Fils, Paris, the agents for A. A. Jones & Shipman, Ltd., Leicester, recently arranged for the despatch of a Jones-Shipman precision grinder by charter aircraft. This machine, which was taken from the reserve held for this agent at the maker's works, was installed in the customer's factory in Paris within 24 hours. An incidental advantage of this method of transport was that the machine could be sent unpacked, with a minimum of preparation.

Union Carbide, Ltd., Kemet Division, 8 Grafton Street, London, W.1, are now marketing solid tantalum capacitors which are claimed to offer considerable advantages from the standpoints of space and weight saving and reliability. These capacitors are at present being imported, but it is planned to start production at the factory at Aycliffe, Co. Durham, in the early summer of 1962.

The Argall Machine Tool Co., Ltd., 162 Buckingham Palace Road, London, S.W.1, the newly-formed machine tool company of the Chamberlain Group, have been appointed sole agents in the United Kingdom and the Commonwealth for the German-built range of Bochumer section-bending machines. There are eight machines in the range, and capacities cover angle sections from 2 by 2 by $\frac{3}{8}$ in. to 8 by 8 by $\frac{7}{8}$ in.

Teddington Air Gauging Equipment.—The gauging divisions of Teddington Industrial Equipment, Ltd., have been transferred as a unit to Teddington Aircraft Controls, Ltd., Cheapside Chambers, Cheapside, Reading, Berks. (telephone, Reading 55235), and all correspondence concerning Teddington air gauges should in future be sent to this address. Increased manufacturing, development, and design facilities will thus be afforded to meet the growing demand for these air gauges.

Dorman Machinery Sales, Ltd., Woodside Hill, Chalfont St. Peter, Bucks., inform us that they have recently been appointed sole United Kingdom agents for the complete range of machines built in the U.S.A. by The Lees-Bradner Co., Cleveland, Ohio. This range includes single spindle gear hobbing machines up to 16 in. diameter capacity; high production rotary hobbers with numbers of spindles from 3 to 8; horizontal spline hobbers; and thread milling machines.

Bowthorpe Holdings, Ltd., Gatwick Road, Crawley, Sussex, and the Deutsch Co. of Banning, California, have agreed to form a jointly owned company, Hellermann Deutsch, Ltd., in which the former will have a 51 per cent holding. The new company will manufacture and market the range of Deutsch connectors for electrical conductors, also the range of connectors and auxiliary equipment made hitherto by the Connectors Division of Hellermann, Ltd. A factory for the new company is to be built at East Grinstead, Sussex, and will be completed during 1962.

Orders for Engineering and Electrical Goods.—The total volume of net new orders received by the industries producing engineering and electrical goods (Order VI of the Standard Industrial Classification), locomotives and railway track equipment, railway carriages and wagons, heavy commercial vehicles and wheeled tractors, in September, was 5 per cent more than a year earlier. New export orders were 4 per cent higher, and home orders, which had fallen during June to August, rallied in September and were 6 per cent more than in September, 1960. In the third quarter new home orders were 2 per cent less and new export orders 3 per cent more than in the corresponding period of 1960. With deliveries rising during September there was little change in the orders-on-hand position, an increase in export orders having been offset by a fall in the figure for home orders.

Trade Publications

IMPERIAL CHEMICAL INDUSTRIES, LTD., Heavy Organic Chemicals Division, Millbank, London, S.W.1. Brochure giving full information on the properties and applications of Thermex heat transfer medium for temperatures up to 400 deg. C.

PANTAK, LTD., Vale Road, Windsor, Berks. Folder, describing the company's 300- and 400-kV mobile X-ray units. Each unit comprises an X-ray tube carried on a stand of parallel link arm design, which, in turn, is mounted on a truck.

PHOTOELECTRONICS (M.O.M.), LTD., Oldfields Trading Estate, Oldfields Road, Sutton, Surrey. Brochure entitled "Photoelectronics in Industry" in which a wide range of equipment is illustrated and briefly described. These items include, for example, an industrial smoke density indicator and alarm.

PARKINSON COWAN INDUSTRIAL PRODUCTS, Fitzalan Street, Kennington Road, London, S.E.11. Booklet describing the range of Parkinson-Schwank gas radiant space heaters for industrial and commercial applications. Types are available for wall, horizontal, and angle mounting, and for pipe suspension.

AEI-BIRLEC, LTD., Tyburn Road, Erdington, Birmingham, 24. Folder describing the Birlec JFC Mk.II electrically heated furnaces for accurate heat treatment at temperatures up to 700 deg. C. These general purpose, batch type furnaces, of vertical cylindrical design, are available with work baskets of 10 in. diameter by 10 or 20 in. deep.

FAWCETT PRESTON & CO., LTD., Bromborough, Cheshire. Publication FP122 describes the company's 10-ton, hand-operated, bench type laboratory hydraulic press, also 50-ton hand-operated, upstroking platen and stereo hydraulic presses. Another publication (No. 123) is concerned with hydraulic presses for compression and transfer moulding of plastics, with capacities from 50 to 400 tons.

SCOTT BADER & CO., LTD., Polyester Division, Wollaston, Wellingborough, Northants. The company's Polyester Handbook, 1961 edition, comprises 130 pages with numerous illustrations and a comprehensive index. There are chapters devoted to general characteristics; chemistry; curing and general formulations; reinforcements; Scott Bader polyester products; ancillary products; mould release agents; gel coats; methods of fabrication; applications; design considerations; quality control; visible flaws and common defects; machining, finishing and repair; and properties.

STEWARTS & LLOYDS, LTD., Broad Street Chambers, Birmingham, 1. Well-produced 38-page brochure (ref. S & L 872) concerned with standard square and rectangular hollow steel sections, which are available in hot-finished welded and hot-finished seamless ranges. Squares from 1 to $3\frac{5}{8}$ in., and rectangles from $1\frac{7}{8}$ by $\frac{13}{16}$ to 5 by $2\frac{1}{2}$ in. outside dimensions, are included in the welded range. The seamless range covers squares of 4, $4\frac{1}{2}$, and 5 in., and rectangles of 5 by $2\frac{1}{2}$, 6 by 3, and 6 by 4 in. Sections of both types are available in various wall thicknesses. Numerous applications in the engineering and building fields are illustrated.

MANUSCRIPTS FOR BOOKS covering all branches of engineering production will receive careful consideration and should be sent to the Manager, Book Dept., MACHINERY, National House, 21 West Street, Brighton, 1.

Matched Machining or Selective Assembly?

(*Continued from page* 1351)

piston is also stamped automatically in accordance with the skirt size classification. In addition, for ease of selection at assembly, pistons of different size grades are segregated as they are discharged from the machine.

To complement these two machines there are others for automatically gauging and classifying connecting rods and cylinder bores, and it is evident that for a very modest addition to the manufacturing cost, such an installation enables a high standard of product quality to be maintained without unreasonable demands on the machine shops.

It is likely that both matched machining and automatic gauging for selective assembly will be increasingly employed in the future to solve the problems of obtaining extremely close fits without prohibitive cost.

Extended Gear Cutting Facilities

Campbells & Hunter, Ltd., Saynor Road, Hunslet, Leeds, a subsidiary of the R. W. Crabtree Group, are extending their gear cutting facilities to cover smaller sizes than have been handled hitherto. To this end, additional equipment is to be provided and a special Sykes HV14 hobbing machine has already been installed, to permit high output of batches of precision gears. This machine is arranged to enable worm wheels down to 3:1 ratio to be machined by hobbing or fly-cutting. Climb or conventional hobbing can be employed for the production of spur and helical gears, splined and serrated parts, and sprockets, with diameters from ½ in. to 14 in.

Personal

Mr. B. Pringle, M.B.E., consultant and manager, Industrial Applications Engineering Department, Motor and Control Gear Division, Associated Electrical Industries, Ltd., Crown House, Aldwych, London, W.C.2, has retired after 47 years' service.

The following new appointments have been announced:—

Mr. Vernon H. Willey, as marketing manager (stainless steels) for Firth Cleveland Steel, Ltd., Rotherham, Yorks.

Mr. E. R. Henschker, A.M.I.Mech.E. and Mr. R. M. L. Elkan, B.Sc.(Eng.), A.M.I.Mech.E., as directors of The Loewy Engineering Co., Ltd., Bournemouth.

Mr. G. Mogford, as works manager of the Croydon factory of Remploy, Ltd., the national organization for employing severely disabled people.

Mr. Hedley Gardiner as Contracting Department manager for Arco Rewinds, Coventry Road, Sheldon, Birmingham, He will be responsible for providing plans and drawings for complete wiring installations for new factories and other buildings.

Mr. C. A. Griffin, as chief engineer (cars) for The British Motor Corporation, Ltd., Longbridge, Birmingham. He has been deputy chief engineer of the Corporation for the past two years.

Mr. W. Crossland, A.M.I.E., as director and general manager of Uni-Tubes, Ltd., 197 Knightsbridge, London, S.W.7, and the subsidiary Portland Plastics, Ltd., and Mr. John Fisher, as sales manager of Uni-Tubes, Ltd.

Mr. K. J. Coleman, B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.E.E., A.F.RAe.S., as chief engineer of Ketay, Ltd., Eddes House, Eastern Avenue West, Romford, Essex, a member company of the Plessey Group.

Mr. G. D. Sparrow, M.I.Prod.E., general manager of the mechanical and works engineering departments, as a director of Atlas Lighting, Ltd., Thorn House, Upper St. Martin's Lane, London, W.C.2.

Mr. F. J. Everest, M.Sc., M.I.Mech.E., as managing director of Vickers Sperry Rand Limited, New Lane, Havant, Hants., (formerly Stein Atkinson Vickers Hydraulics, Ltd.). He succeeds Mr. C. H. Williams, who has resigned from this office, but continues to hold the position of chairman of the board.

Obituary

Mr. W. H. Heron, group works engineering director of Raleigh Industries, Ltd., Nottingham, has died at the age of 65, after being ill for several months. A native of Halifax, he had completed more than 40 years' service with the company. For the first 11 years he worked as a press tool maker, rate fixer and estimator, and subsequently held various positions of increasing importance.

Scrap Metals

Midlands.—Although there has been no general improvement in the demand for ferrous scrap, one Midland steelworks has been able to take slightly higher tonnages of basic steel material. The increase in allocations may only be temporary, but in the circumstances prevailing, local merchants are glad of any outlet, however small, for disposal of processed scrap. Except for a few special orders for first quality short heavy material, merchants are without markets for foundry steel, and lower grades such as shovelling scrap are only being bought at steelworks prices. Movement of chipped and bushy steel turnings is still limited and it is unlikely that prices will improve as demand for export is equally poor.

Cast iron scrap continues to move reasonably well. Demand for the lighter material is not as strong as formerly, but merchants have found that as one market closes another opens, and material is cleared at fairly stable prices.

The position at many merchants' yards, with stocks increasing in spite of reduced buying prices, is causing concern, and it is to be hoped that allocations will be considerably increased early in the New Year.

Offers for scrap from local factories for next year are now being made, and it is likely that prices will take second place to guarantees of regular clearance by the merchants who secure the contracts.

Machine Tool Share Market

The undertone of stock markets was firm during the period under review, but quiet conditions prevailed in most sections. Buying interest was selective, and, in general, price changes were small and irregular.

After it had remained steady for the most part, there was a reaction in the gilt-edged section, and British Funds, together with home corporation and Dominion loans, finished with small declines.

A satisfactory tone was maintained in the commercial and industrial markets. Although there was some irregularity in price movements, the majority of changes were to slightly higher levels. Towards the close, however, an easier tendency developed.

Among machine tool issues, Abwood Machine Tool advanced 3d. to 1s. 6d.; Arnott & Harrison, 6d. to 12s. 6d.; British Oxygen, 1s. to 15s.; Clarkson (Engineers), 4½d. to 7s. 3d.; Coventry Gauge & Tool, 1s. to 32s. 7½d.; and Samuel Osborn, 6d. to 53s. On the other hand, Edgar Allen lost 6d. at 31s.; Birmingham Small Arms, 6d. at 18s. 6d.; Greenwood & Batley, 10½d. at 16s.; John Harper, 4½d. at 7s. 10½d.; H. W. Kearns, 1s. at 20s. 3d.; Kerry's (Gt. Britain), 3d. at 8s.; and Ambrose Shardlow, 1s. 3d. at 53s. 9d.

CHARLES CHURCHILL & CO., LTD. Interim dividend 8½ per cent (same).

AMBROSE SHARDLOW & CO., LTD. Interim dividend 4 per cent (same).

*New Companies Registered**

LEAMINGTON PATTERN (ENGINEERING), LTD., Queensway Trading Estate, Leamington Spa. Registered November 28, 1961. To carry on the business of precision engineers, etc. Nom. cap.: £5,000. Directors: L. A. T. Willis, R. W. Mousley and F. G. Wiggins.

ARNOTT & HARRISON (TOOLMAKERS), LTD.—Registered November 28, 1961. To take over the business of engineers and manufacturers carried on at Willesden, London, N.W.10 by Arnott & Harrison, Ltd. Nom. cap.: £100,000. Directors: J. C. Jones, F. W. Halliwell, L. Bunn and S. C. Clifton.

NECCHI (GREAT BRITAIN), LTD., 9 Cavendish Square, London, W.1. Registered November 27, 1961. To acquire a licence or agency for the importation, manufacture and sale of the Necchi sewing machine in the United Kingdom. Nom. cap.: £50,000. Directors to be appointed by subscribers. Subscribers: G. K. Goddard and J. Black, 9 Cavendish Square, W.1.

* From the lists compiled by Jordan & Sons, Ltd., Company Registration Agents, 116-118 Chancery Lane, London, W.C.2.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	1/6
Allen (Edgar) & Co., Ltd.	Ord.	£1	31/-
" " "	5% Prf.	£1	13/3
Arnott & Harrison, Ltd.	Ord.	4/-	12/6xd
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	10/-
" " "	6% Cum. Prf.	£1	16/6
Birmingham Small Arms Co., Ltd.	Ord.	10/-	18/6
" " "	5% Cum. "A" Prf.	£1	13/-
" " "	6% Cum. "B" Prf.	£1	16/6
" "	4% 1st Mort. Deb.	Stk.	90½xd
British Oxygen Co., Ltd.	Ord.	5/-	15/-
" " "	6% Cum. Prf.	£1	18/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	7/7½
Broom & Wade, Ltd.	Ord.	5/-	22/-
" "	6% Cum. Prf.	£1	16/-
Brown (David) Corporation, Ltd.	5½% Cum. Prf.	£1	14/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/-
Butler Machine Tool Co., Ltd.	Ord.	5/-	15/-
" " " "	5% Cum. Prf.	£1	12/6
Churchill (Charles) & Co., Ltd.	Ord.	2/-	8/7½
" " "	6% Cum. Prf.	£1	25/7½‡
Clarkson (Engrs.), Ltd.	Ord.	1/-	7/3
Cohen (George), 600 Group, Ltd.	Ord.	5/-	9/6
" " "	4½% Cum. Prf.	£1	12/-
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	32/7½
" " "	5% Cum. Red. Prf.	£1	16/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	8/4½
Elliott (B.) & Co., Ltd.	Ord.	1/-	2/9
" "	4½% Red. Cum. Prf.	£1	11/3xd
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	10/6
Greenwood & Batley, Ltd.	Ord.	10/-	16/-
Harper (John) & Co., Ltd.	Ord.	5/-	7/10½
" " "	4½% Red. Cum. Pref.	£1	9/6

COMPANY		Denom.	Middle Price
Herbert (Alfred), Ltd.	Ord.	£1	64/-
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	20/-xd
" "	"B" Ord.	5/-	17/9xd
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	25/-
" " "	7% Cum. Prf.	5/-	4/6xd
Kearney & Trecker-C.V.A., Ltd.	5½% Red. Cum. Prf.	£1	8/9
" " "	Prefd. Ord.	£1	13/9
Kearns (H. W.) & Co., Ltd.	Ord.	5/-	20/3xd
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	8/-
Macreadys Metal Co., Ltd.	Ord.	5/-	15/-
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/6
Massey (B. & S.), Ltd.	Ord.	5/-	11/-
Newall Engineering Co., Ltd.	Ord.	2/-	7/-
Newman Industries, Ltd.	Ord.	2/-	7/-
" "	6% Prf. Ord.	5/-	5/-
Noble & Lund, Ltd.	Ord.	2/-	5/6
Norton, W. E. (Holdings), Ltd.	Ord.	2/-	9/6xd
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	53/-xd
" " " "	5½% Cum. Prf.	£1	22/-
Pratt (F.) Engineering Corporation, Ltd.	Ord.	5/-	14/6
Sanderson Kayser, Ltd.	Ord.	10/-	34/3
" "	6½% Cum. Prf.	£1	16/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	7/9xd
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	53/9
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	14/4½
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	21/9xd
" " "	5% Cum. Prf.	£1	13/3
Stedall & Co., Ltd.	Ord.	5/-	7/6
Sykes (W. E.), Ltd.	"B" non-voting Ord.	10/-	24/4½
Tap & Die Corporation, Ltd.	Ord.	5/-	19/-
" " "	4½% Deb. 1961-1977	Stk.	81½
Wadkin, Ltd.	Ord.	10/-	26/-
Ward (Thos W.), Ltd.	Ord.	£1	65/-
" "	5% Cum. 1st Pref.	£1	13/6
" "	5% Cum. 2nd Pref.	£1	20/-
Willson Lathes, Ltd.	Ord.	1/-	2/6

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. ‡ Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig Iron* (10 tons or over)

Foundry and Forge
No. 3, Class 2

Middlesbrough	£21 17 0
Birmingham (10 tons or over)	£21 9 3

Phos. Over 0·1 up to 0·4%

Birmingham	£23 5 0
Grangemouth	£23 10 0

Hæmatite

N.E. Coast (made in N.E.)	£23 19 0
Scotland (made in Scotland, zone S.1.)	£24 5 6
Sheffield	£25 9 0
Birmingham	£25 13 0
S. Wales (made in Wales)	£23 19 0

Steel Products*

Medium plates (50 tons and over)	£43 16 6
Mild steel plates, ordinary (50 tons and over)	£40 7 0
Boiler plates (50 tons and over)	£42 17 0
Flat bars, 5 in. wide and under (50 tons or over)	£39 1 0
Round bars, under 3 in. (50 tons or over)	£39 1 0
Billets, rolling quality, soft U.T. (100 tons or over)	£31 15 6

Phosphor Bronze

Ingots (2B8) (A.I.D.) d/d	£312 0 0

Copper

Cash (mean)	£228 17 6
Cold rolled and hot rolled sheets 4 ft. by 2 ft. by 10 SWG	£303 15 0
Rods, 5/16 in. to ¾ in. diam	£320 10 0
Tubes, 1½ in. bore by 10 SWG, ton lots, per lb.	3s. 1⅞d
Wire rod, black, hot-rolled (¼-5/16 in.), English	£244 7 6

Zinc

Refined, minimum 98 per cent purity, current month (mean)	£70 8 9

Brass

Tubes, solid drawn, basis per lb.	1s. 9⅜d.
Strip 63/37, 6in. by 10 SWG coils, ton lots	£253 5 0—£256 5 0
Rods, ¼-3 in. diam. (59 per cent copper)	2s. 0d.

Yellow Metal

Condenser plates, per ton	£184 0 0
Rods, per lb.	2s. 1d.

Aluminium

Ingots, min. 99·5 per cent Canadian d/d	£186 0 0

Tinplates

**U.K. Home trade: Cold reduced, f.o.t. makers works (15-50 tons)	£3 7 8½
U.K. Export: hot dipped Cold reduced (strip mill), basis	73s. 6d.—76s. 0d.

Gunmetal

Ingots, B.S. 1400 L.G.2, delivered	£209 0 0

* Subject to increase of 1 per cent.
** Subject to allowances and extras.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 1 in. up to 2·21 and 2·41 a/f ex works, 2 tons basis	£42 17 6†
Free cutting black	£46 14 6†

Reeled Steel Bars[1]

Single-reeled, 1½ in. upwards, f.o.t. works (+ usual extra for sizes)	£43 9 0†
Free cutting	£47 7 0†

Precision-ground Mild Steel[2]

1-in. diam ± 0·00025-in. 4-ton lots, per cwt.	124s. 6d.†

Bright Ground Stainless Steel Bars[3]

EN56AM (martensitic, free cutting)	£304 10 0
EN58AM (austenitic free cutting)	£377 10 0

Prices are basic, subject to extras.

High-speed Steel

Black random length bar. All prices basic, per lb., subject to extras:

Molybdenum "66"	6s. 5d.
Molybdenum "46"	6s. 3d.
14 per cent tungsten	6s. 11d.
16 per cent tungsten	7s. 4d.
18 per cent tungsten	7s. 9d.
22 per cent tungsten	9s. 2d
5 per cent cobalt	10s. 10d.
4·75/5·25 molybdenum + 6·0/6·75 tungsten + 1·75/2·05 vanadium per cent (5-6-2)	6s. 7d.

Precision-ground, High-speed Free-turning Brass Rod[2]

⅜-in. diam. ±0·00025-in., 2 ton lots, per lb.	2s. 7⅜d.

Grey Iron Rod

Die Cast[4] in random lengths 23 in. to 26 in. rough machined 1/32 in. to 1/16 in. above listed size, according to diameter. Extra for shorter lengths.

	Per cwt. delivered. Mark I	Mark III
1 or 1⅛ in.	208s. 0d.	266s. 3d.
1¼ to 1½ in.	145s. 6d.	181s. 6d.
1⅝ to 2 in.	112s. 6d.	132s. 6d.
2⅛ to 3½ in.	96s. 6d.	112s. 6d.
3⅝ to 14 in.	90s. 9d.	105s. 0d.

Continuous Cast[5]

10-ft. lengths centreless ground +0·010 in. Extra for hardenable alloy iron.

	Per cwt. net.
1 or 1⅛ in.	208s. 4d.
1¼ to 1½ in.	146s. 3d.
1⅝ to 2 in.	112s. 7d.
2⅛ to 3½ in.	97s. 1d.

Stellite[6]
Welding Rods, plain

¼ in. diam., per lb.	30s. 0d.

Toolbits

¼ in. sq. × 4 in., each	22s. 3d.

1 Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. 2 Pratt, Levick & Co., Ltd., Chester. 3 Spartan Steel & Alloys, Ltd., St. Stephens Street, Birmingham, 6. 4 Metals & Alloys (Birmingham), Ltd., Minworth, Sutton Coldfield. 5 "Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen. 6 Deloro Stellite, Ltd., Highlands Road, Shirley, Solihull.

† Plus 1 per cent.

BASIC PRICES FROM LONDON STOCK[8]

Free Cutting Steel

Bright cold drawn:

(Usaspead) over 1 to 2 in.	£59 4 6‡
Lead bearing (Usaled)	£63 11 0‡
Precision ground, 1⅜ in.	£84 14 6‡

Bright Drawn

M.S. bars (M.M.C.) over 1½ to 2 in.	£56 10 0‡
Square edge flats (Usaflat)	£73 6 6‡
M.S. angles (Usaspead)	£100 6 6‡
Case hardening (EN) (Usacase) over 1½ to 2 in.	£62 10 0‡
M.S. bars (EN3B) (Usamild) over 1½ to 2 in.	£58 16 6‡
Carbon manganese semi-free cutting case hardening (EN202) (Usaspead 202) over 1½ to 2 in.	£71 5 0‡
35/45 ton tensile (EN6) (Usen) over 1 to 1½ in.	£67 3 0‡
0·4 carbon normalized (Usaspead "40") over 1½ to 2 in.	£69 5 0‡
0·45 carbon normalized EN9 (Usaspead 55)	£69 15 0‡
Carbon manganese steel to Specification EN16T (Usaspead 5565), per ton	£127 1 6

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspead). List prices plus 10 per cent. less 5 per cent.

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.), ¾ in. to 2½ in. per lb.	1s. 11d.
Non-distorting heavy duty (Usaspead H.C.H.C.), ¾ in. to 2½ in., per lb.	4s. 2d.

Silver Steel

(0·194-in. to 1½-in.). Genuine Stubs quality, per lb.	4s. 10d. less 27½%
M.M.C. quality, per lb.	2s. 8d. + 6½%
Boxes of 16 assorted sizes, 1/16 in. to ⅜ in. diam.	7s. 6d.

Stainless Steel

KE40AM (free cutting), per lb.	3s. 4d.

Glacier Machined Bronze Bars

Phosphor bronze (2B8) / Lead bronze	Prices on application

High-speed Steel

18 per cent tungsten. Prices on application

Toolholder bits:

Usaspead "Super" / " "Supreme" / " Cobalt 10	List price

Shimstock

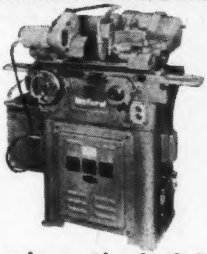
Steel assorted, per tin	3s. 6d.
Brass " "	7s. 3d.

8 Macready's Metal Co., Ltd., Pentonville Road, N.1. Subject to confirmation by London Office. Delivered free by van in London area.

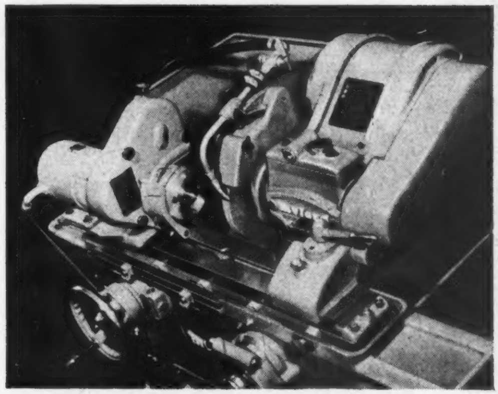
‡ Plus 1 per cent.

Myford MG 12
(5" × 12")

precision grinding
...costs less with a Myford CYLINDRICAL GRINDER



The cost is low . . . it can be used for plain, internal, taper, conical, face grinding etc. . . . is regularly used for surface finishing down to one micro-inch . . . has a repetitive accuracy of 0·00005 inch.



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Hand scraped and surfaced to within 0·0001in. to 0·0003in. from a mean true plane over whole surface according to size.

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Smooth planed finish accurate 0·001in to 0·003in. according to size.

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Sizes 4ft. by 3ft. to 6ft. by 4ft. have five-point adjustable support.

Sizes 8ft. by 3ft. to 12ft. by 6ft. have six-point adjustable support.

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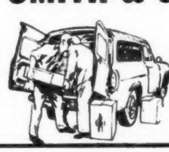

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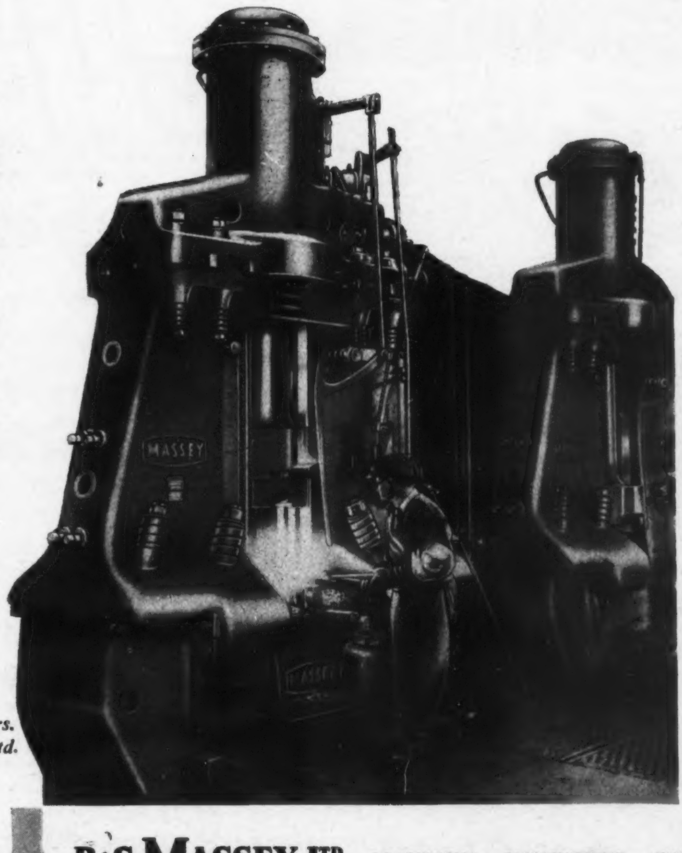

20 cwt. 'Ram' type Double-Acting Drop Hammers. Messrs. Austin Motor Co. Ltd.

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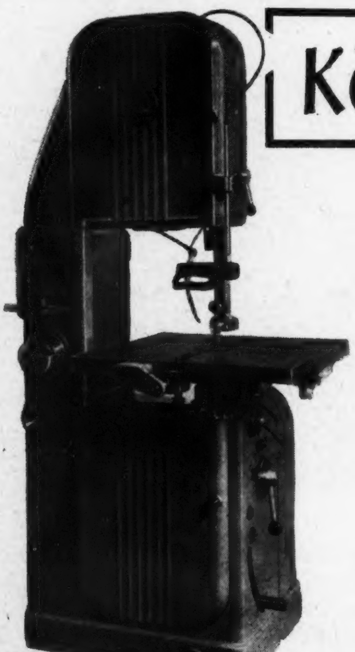

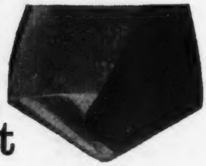

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Drill points can be changed to suit different requirements quickly and easily, without the need of a skilled operator.
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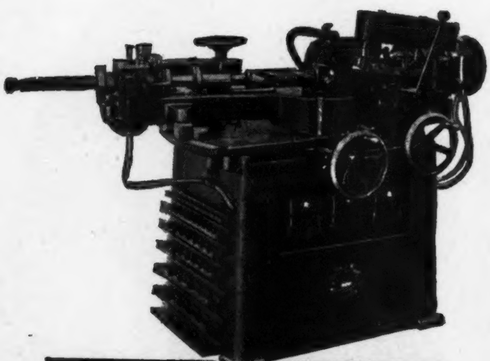

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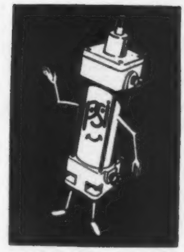
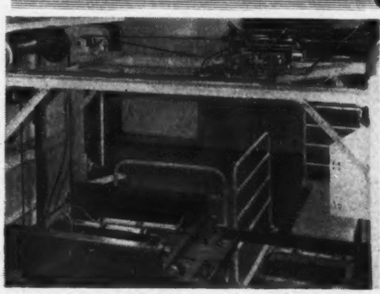


... was made for the worker with the boss-class in mind



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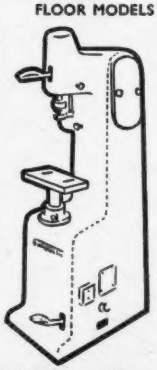

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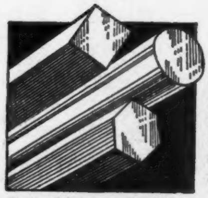

Bright drawn, heat-treated, carbon and alloy steel bars in Hexagons, Squares and Rounds, in all sizes up to $3\frac{1}{2}$ in. dia. Special qualities and-or special sizes can be supplied.

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The 'Selfeedril' is a self-contained unit head with built in forward and reverse mechanism, rapid approach and feed speed adjustment. Only one air hose is needed to supply each unit, and control is by a single elementary on-off valve. Maximum chuck capacity ½" dia. Forward feed 1½" and 2½"

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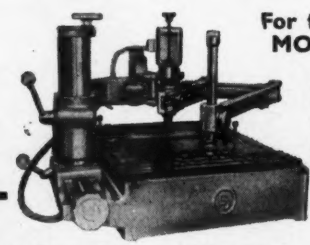

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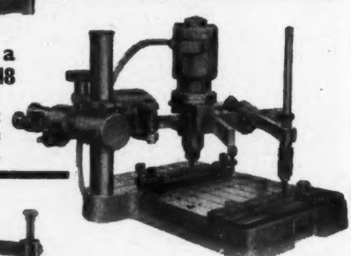
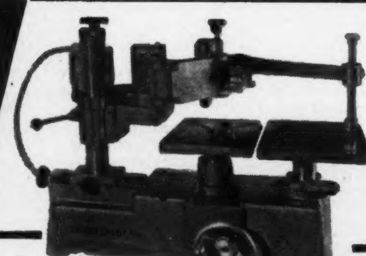


A first class machine at a really low price MODEL 848
Reduction range 2:1 to 4:1. Vertical adjustment to suit workpiece height. Coverage from 5in. × 3in. to 2¼in. to 1¼in.



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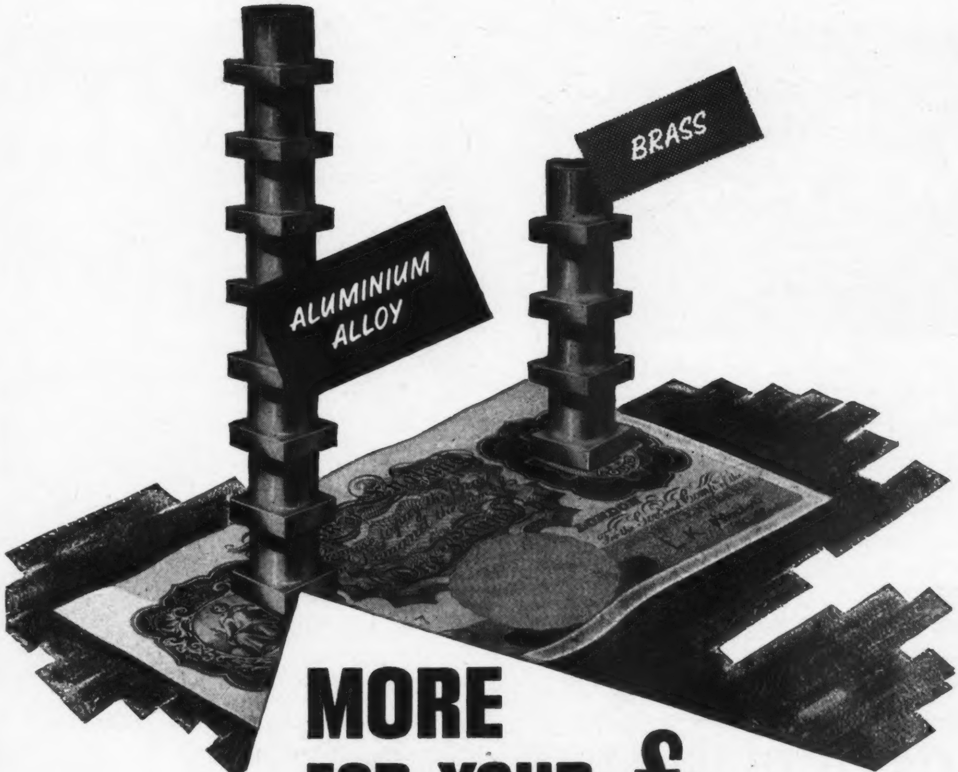

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Small chips eliminate swarf "build up" at tool tip.

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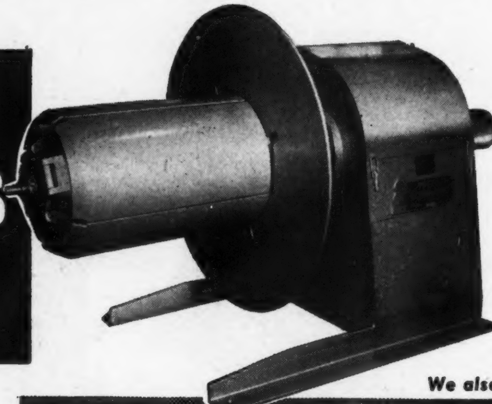
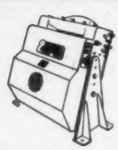
PRESS EQUIPMENT COIL REELS

for decoiling and rewinding



This wide range of coil reels includes free-running and motorised models for coils up to 48" wide and 15,000 lbs. weight. Mandrel expansion can be hand or power operated.
Motorised machines have electric clutch and/or stepless variable speed control.
Reels are available with lateral spindle adjustment, tensioning device, coil loading car equipment, and powered track mounting.

We also manufacture:—



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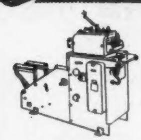

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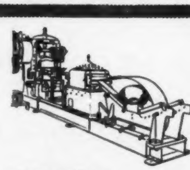

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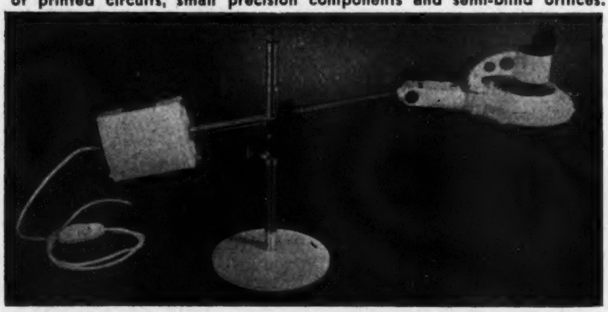

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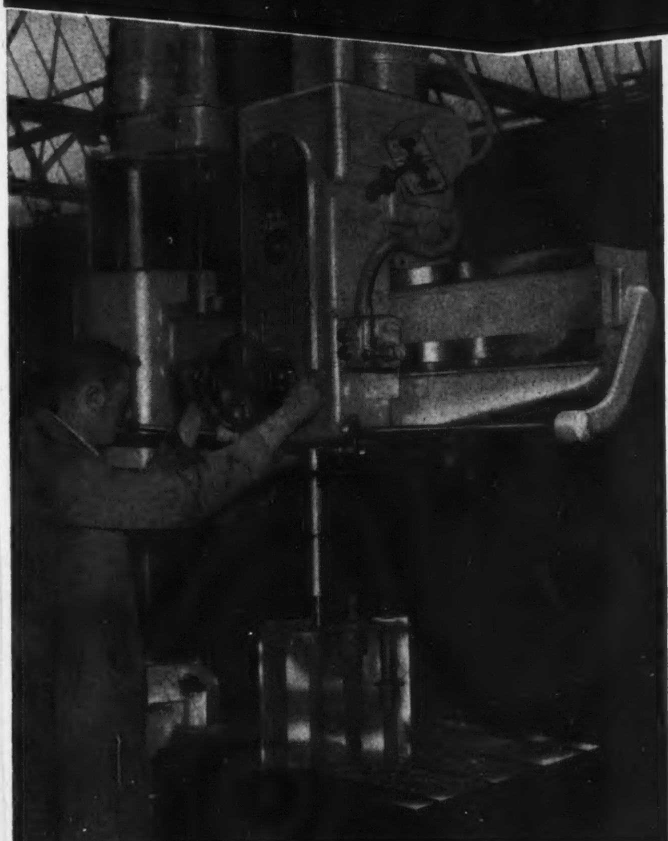

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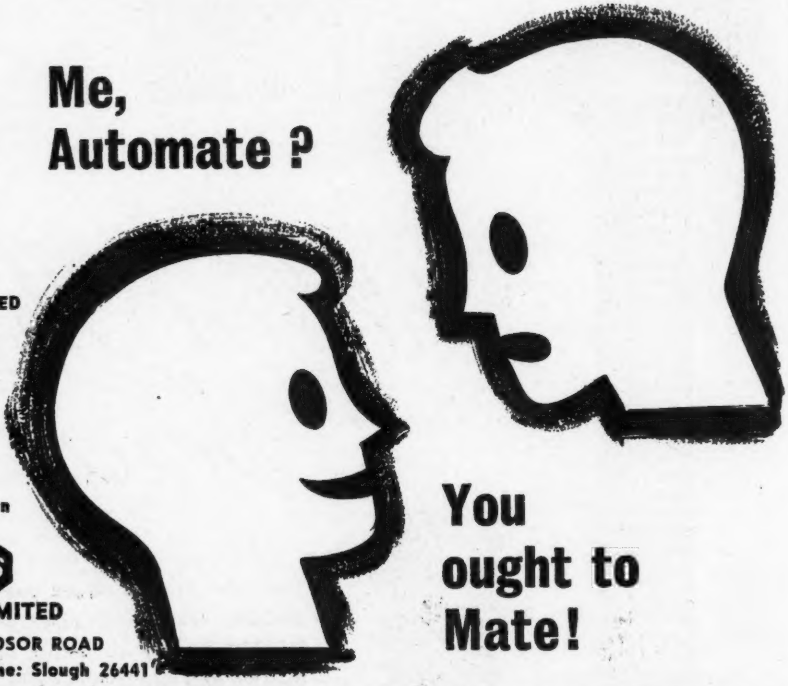

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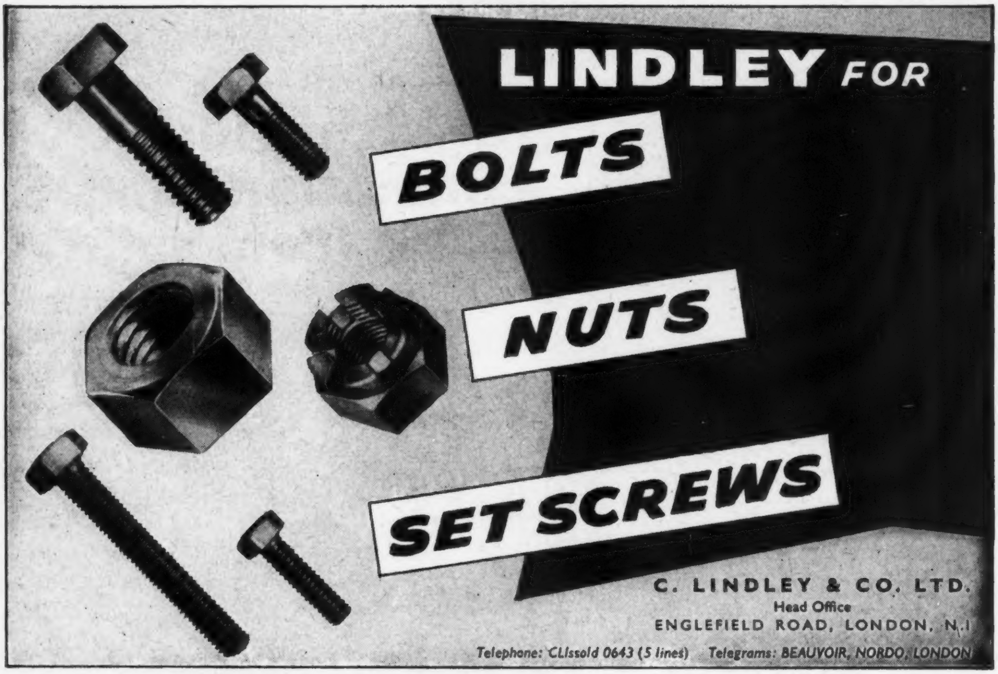
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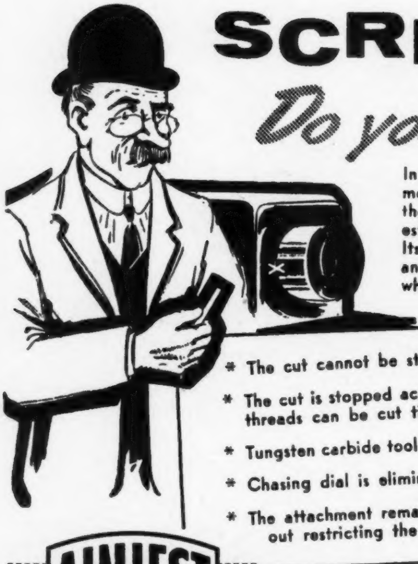

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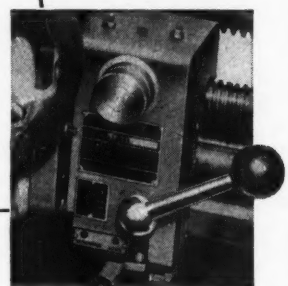

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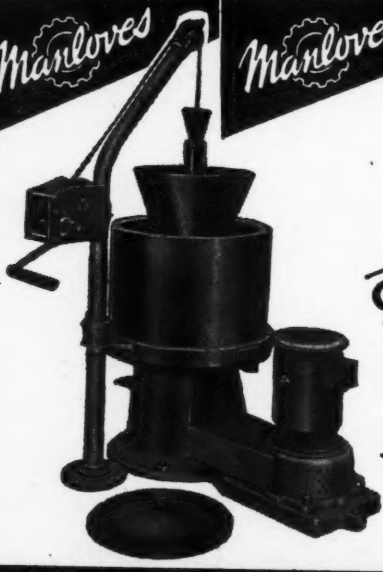

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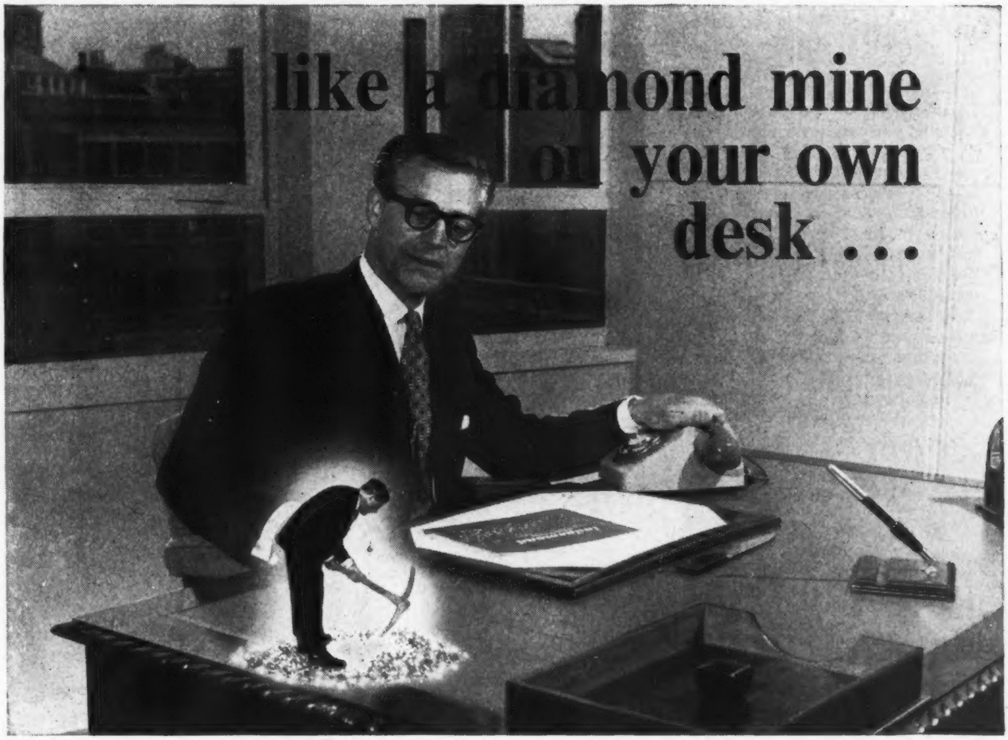

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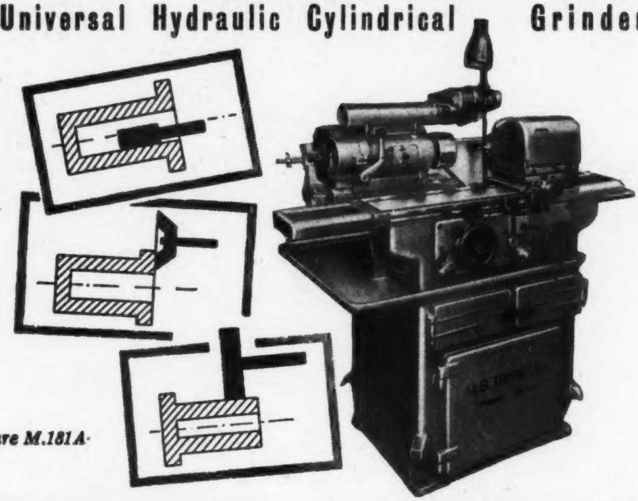

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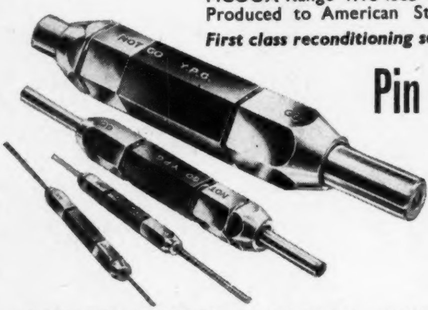

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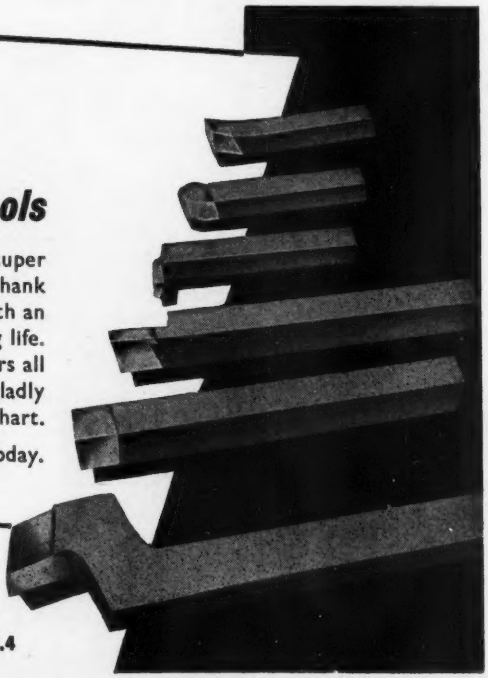

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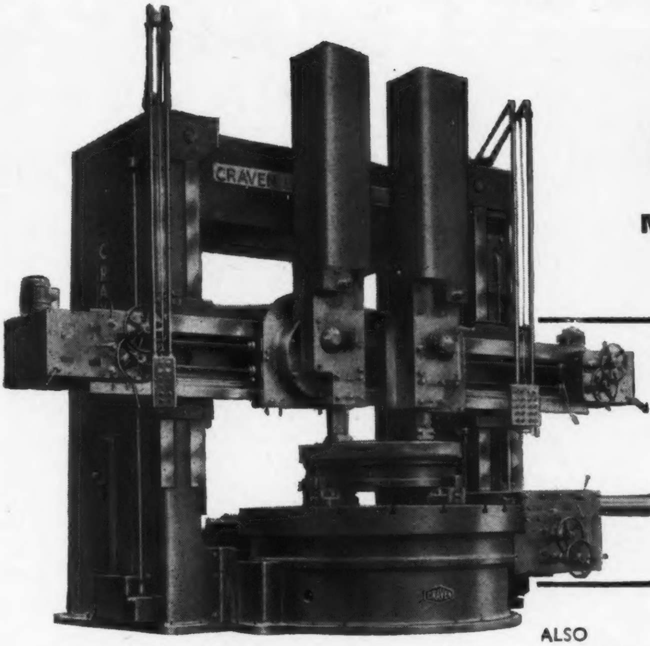

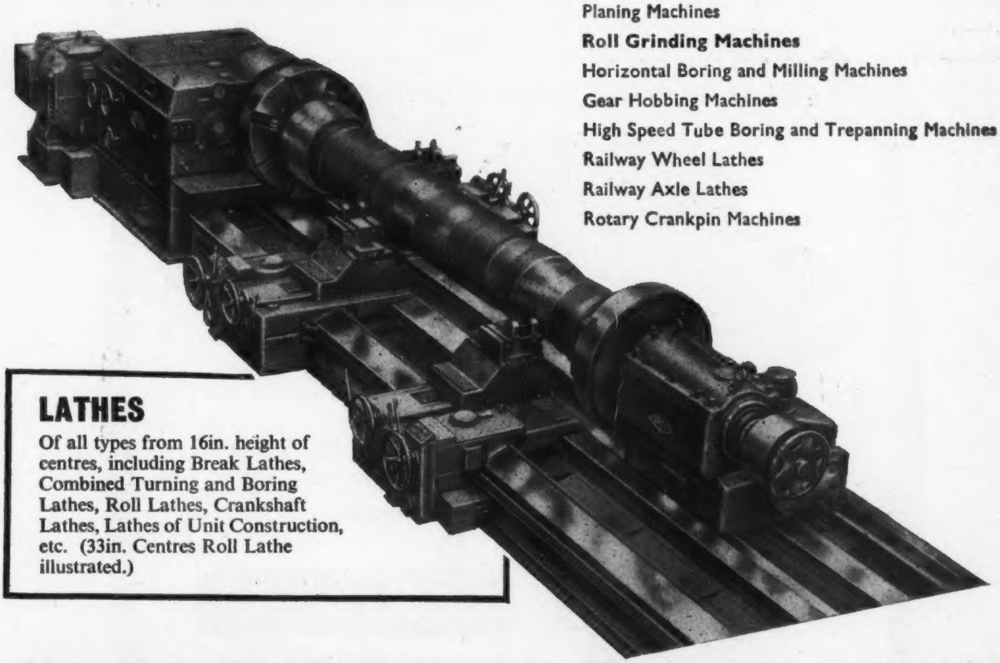

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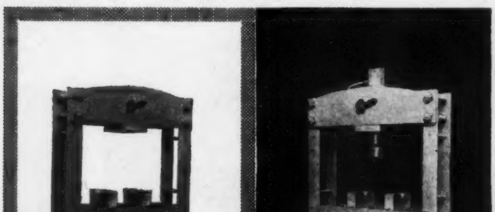

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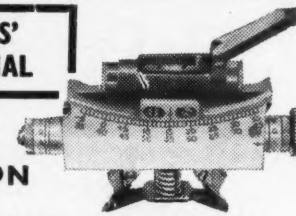

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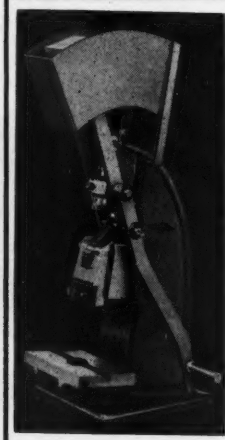

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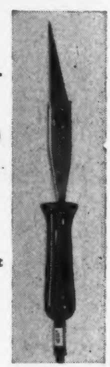

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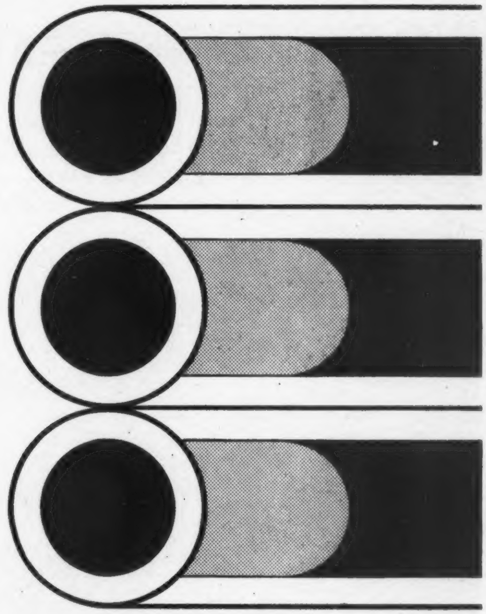

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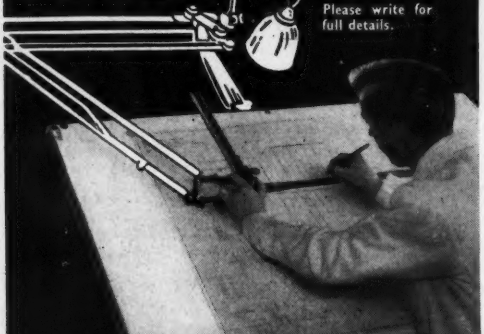

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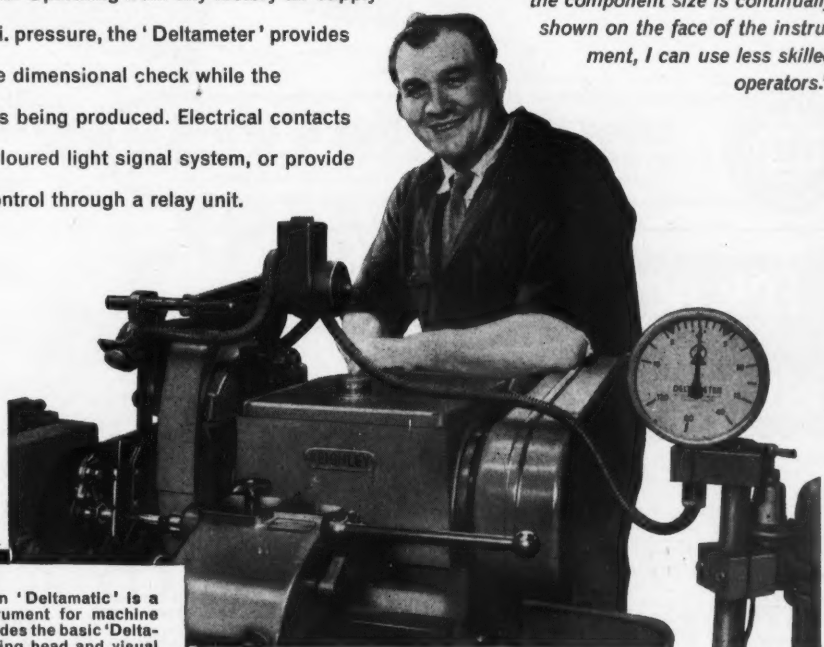

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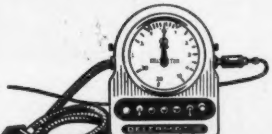

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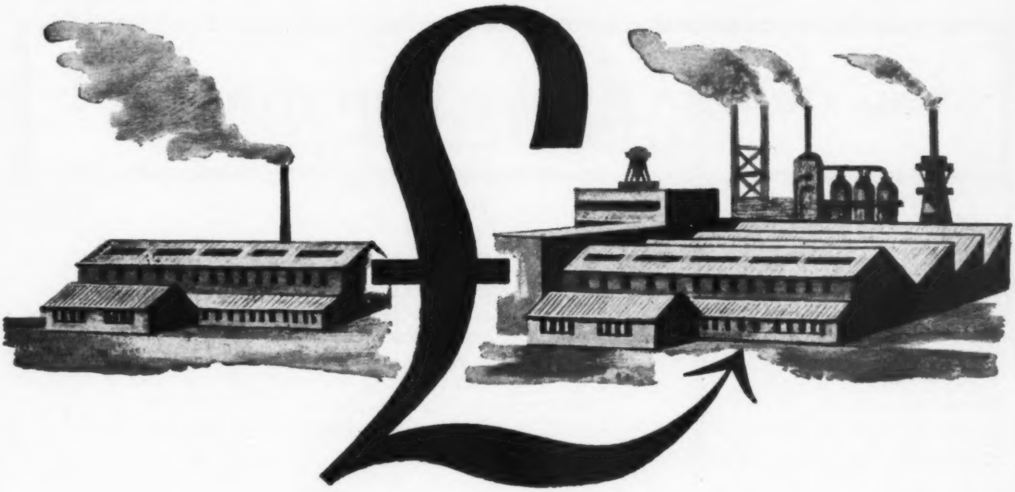

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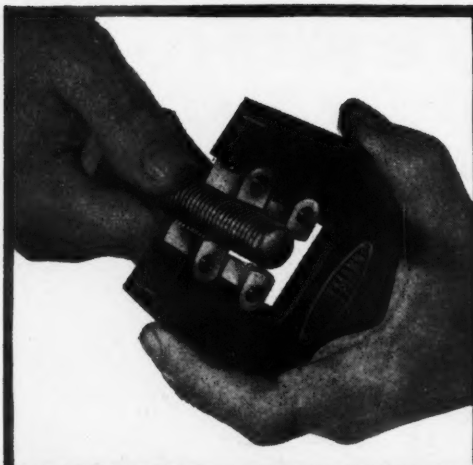

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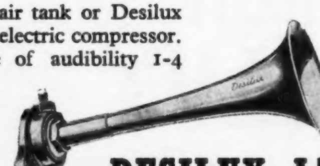

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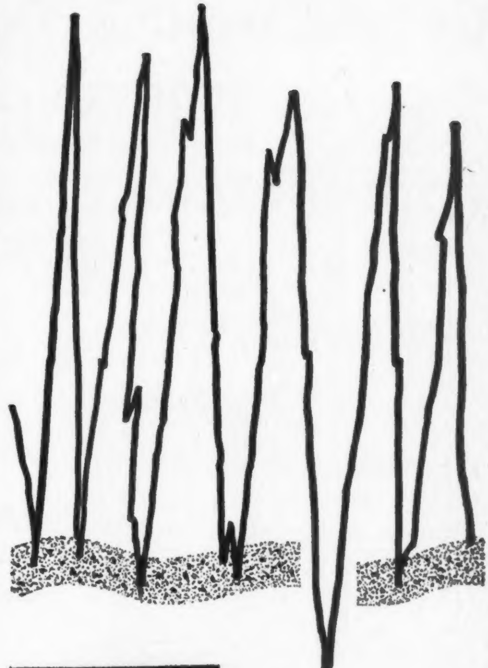

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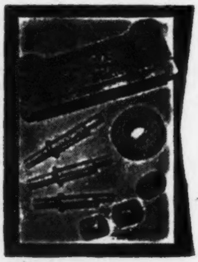

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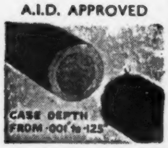

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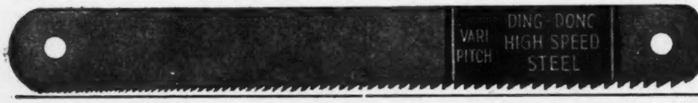

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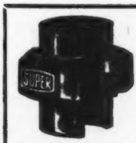

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SMART & BROWN 1024 6in. centres, Precision Toolroom Lathe, admits 2ft. 0in. between centres.
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All with electrical equipment for 400-440/3/50 cycles supply.

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FOSTER No. 2B Turret Lathe.

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CORONA 2 Spindle Drill.
SCRIVENER 1CA Centreless Grinder.
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K. & T. 5HM Vertical Mill 1,300 r.p.m.
K. & T. 4H Horizontal Mill.
MANN 6ft. B.C. Threadmill.
MILWAUKEE 12in. × 18in. Simplex Mill
SENTINEL 25T Power Press.
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THIEL Punch Shaping Machine.
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FELLOWS 61A High Speed Gear Shaper.
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15 Ton Heywood, 34ft. span, cab control.
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HERBERT No. 5 Auto Chucking Lathe, swing 18¾in. over bed. 3⅛in. hollow spindle.

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KENDALL & GENT Screwing Machine, 3in. bolts, 6in. tubes. Tangential diehead with leadscrew.
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OSTER 6in. capacity Screwing Machine with cutting-off attachment for pipes; fully equipped.
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LANDIS 1¼in. Tangential Diehead Screwing Machine.

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ORMEROD 26in. stroke Traversing Head Shaping Machine, with two universal box tables. 1955 machine.

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NEW 7½in. stroke Toolroom Slotters.

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WEBSTER & BENNETT 36in. Vertical Boring Mill with Murray colour control, 6.5 to 124 r.p.m.
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LELAND-GIFFORD 3-spindle Drilling Machine on 4-spindle base, with 4-speed direct mounted motors, No. 3 Morse Taper.
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ARCHDALE and **POLLARD** No. 3, 4 and 5 Morse Taper Production Drilling Machines.
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24in. **INVICTA** Model 6M Shaper.
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59in. × 16in. **CRAVEN** Victoria Milling Machine.
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Model HBY **CHURCHILL** Electric Grinder.
14in. **BUTLER** Slotter. Power revolving table.
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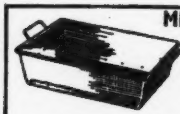

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ASQUITH Floor Type Horizontal Borer, 3in. diameter travelling spindle, swivelling column with 6ft. × 5ft. tee-slotted bedplate.

SLOTTING MACHINE
ORMEROD 12in. stroke Slotting Machine, 27in. dia. rotary table.

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MITCHELL OF KEIGHLEY 8½in. S.S. & S.C. Gap Bed Lathe, to admit 7ft. 3in. between centres.

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ST. ANDRE Horizontal type Heavy Duty Plain Milling Machine, table size 73in. × 16½in.
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C.V.A. "Kearney & Trecker" model 2E Dia. Type Horizontal Plain Drilling Machine, working surface of table 41in. × 12in., longitudinal feed 29in., cross feed 12in., 8 spindle speeds 25/1,000 r.p.m.
CINCINNATI Model 3/36 Hydromatic Milling Machine, table 54in. × 14in.

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CINCINNATI 10 ton Vert. Single Ram Hydraulic Surface Broaching Machine, 66in. stroke, 20in. × 20in. table.

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LANDIS 10in. × 24in. Universal Grinding Machine, with hydraulic feed and internal grinding attachment.
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JONES & SHIPMAN Fig. 540 18in. × 6in. Hydraulic Horizontal Spindle Surface Grinding Machine, with 14in. × 6in. magnetic chuck.
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BESCO 40 Ton. Adj. stroke and bed. £425.
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BESCO 4 Ton. Adj. stroke. As New. £125.
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BULLARD Multi-Au-Matic 7in. 8 spindle.
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WETZEL Horizontal traversing column Floor Boring and Facing Machine, 7in. diameter travelling spindle, 45in. diameter facing head.
KEARNS Model OC Horizontal Boring Machine, 3in. dia. travelling spindle.
WEBSTER & BENNETT Vertical Boring Machine, table 50in. diameter.
RICHARDS Type PRT Horizontal Floor Boring Machine, 3½in. travelling spindle, 28in. diameter facing head.

LATHES
DEAN, SMITH & GRACE S.S. & S.C. Gap Bed Centre Lathe, 8½in. centre height × 48in. between centres.

CAPSTAN AND CENTRE LATHES
CHURCHILL-REDMAN Model 13NM Heavy Duty S.S. & S.C. Gap Bed Centre Lathe, 13in. centre height × 72in. between centres. Swing in gap 50in.
OLDFIELD & SCHOFIELD Surfacing and Boring Lathe, 10½in. centre height.
WARD 7B Combination Turret Lathe.
NILES Heavy Duty Centre Lathe, S.S. & S.C. 17in. centre height × 28ft. between centres.

DRILLING MACHINES
ASQUITH Model OD.1 5ft. Elevating Arm Radia Drilling Machine.
HETTNER Radial Drilling Machine, 10ft. elevating arm.

GEAR MACHINES
ORCUTT Model HM24 Hydraulic Interna Gear Grinder.
GLEASON 3in. Straight Bevel Gear Generator.

GRINDING MACHINES
NEWALL Type LA Plain Hydraulic Cylindrical Grinding Machine, 10in. × 36in. (Two available.)
CHURCHILL Model HBY Internal Grinding Machine.
CHURCHILL Plain Cylindrical Grinding Machine, 26in. swing × 84in. between centres (1951).
LANDIS Type C Plain Hydraulic Cylindrical Grinding Machine, 6in. swing × 18in. between centres.
ORCUTT Model HM24 Internal Spur Gear Grinding Machines.
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BROWN & SHARPE Plain Cylindrical Grinding Machine, 10in. swing × 36in. between centres.
SCRIVENER Model 2DF Centreless Grinding Machine.

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CINCINNATI Model 5/72 Plain Hydromatic Milling Machine, table 91in. × 22in. (1952).
CINCINNATI No. 2L Plain Horizontal Milling Machine, table 52in. × 10in.
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Ward 2A air collet chuck.
Herbert 2S 1¼in. bar cap.
Herbert 4BS

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Le Blond "Regal" S.S. & S.C. 8in. × 36in.
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Archdale 20in. horiz. Very good condition.

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⅞in. **ACME GRIDLEY** 4 spindle, G Model Bar Auto.

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LAPOINTE Vertical 8 ton, 36in. stroke.
CVA British Broaching Machine 6 ton, 36in. stroke.

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LATHES

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LE BLOND Production Lathe, 7in. centres by 36in. between.
TRIDENT Gap Bed 6½in. by 60in.
SPRINGFIELD 24in. by 12in. centres by 60in. between, speeds 9 to 280 r.p.m.
HOLBROOK Model 16H A.G.H., 1,000 r.p.m. SS & SC, 8in. by 36in.
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HERBERT No. 0.
GISHOLT No. 3 Simplified Capstan.
MODERN No. 1.
WARD 3A Capstans.
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ARCHDALE with 120 Hobs.
WANDERER. 3in. capacity.

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THIEL Model 58 Tool Room Mill.
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CINCINNATI No. 3 Vertical Sliding head (overhauled).
ALEXANDER No. 2, 3 Dimensional Pantograph Machine.
HERBERT No. 1 Hand Mill.
EDGWICK Horizontal Machine.
MAXIMA Horizontal Power Feed 30in. by 10in.
CINCINNATI No. 3 Horizontal Dial Turret Machine. Dual Control.

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TAYLOR & CHALLEN Type 1413 40 ton Variable stroke—Guards.
85-ton **RHODES** Upright Geared.
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25-ton **RHODES** Inclinable.
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FLY PRESSES No. 3.
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MIDSAW Standard Toolroom Band Saw and Filing Machine, 20in. Capacity.
300 KVA **SCIAKY** Projection Welder, Electronic Control Panel. The whole unit hardly used, in new condition, approx. 3 years old.

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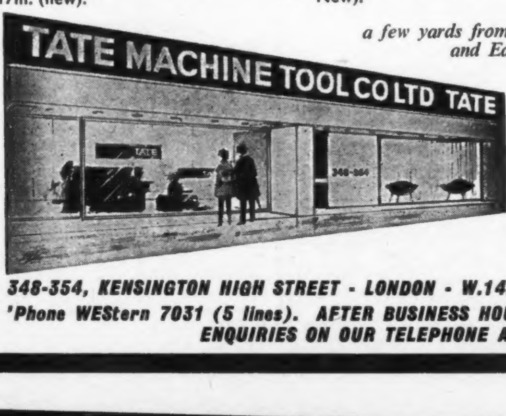

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Hilmor Motor Driven Tube Bending Machine for sale. Mandrel type. Max. capacity: copper tubes 2¼in. bore × 10 gauge; steel tube 2in. O.D. × 10 gauge; conduit 2in. O.D.; gas and steam tubes 1¼in. nominal bore. Motor drive 400-440/3/50.—F. J. EDWARDS LTD., 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

Automatics. Acme Gridley model R. ⅝in. Four-spindle; Cleveland 1$\frac{5}{16}$in. model "A" Single Spindle; Index "O" $\frac{9}{16}$in. Single Spindle; Brown & Sharpe "OO" High Speed Single Spindle with motor.—HICKS MACHINERY LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333.

MIDLAND

COMPRESSORS

BROOM & WADE D22 100 lb. Compressor.

DRILLING MACHINES

PROGRESS No. 3 Pillar Drill. 1in. cap.
ASQUITH OD1 3ft. 6in. Radial. No. 5 M.T. D.C. Electrics.
PROGRESS 4E Pillar Drill. 1¼in. cap.

GRINDING MACHINES

NEW N.I. 10in., 12in., 14in., 16in. and 20in. D/E Tool Grinders.
RUSSELL 40in. Saw Blade Sharpener.
PRECIMAX M.P.H. 10in. × 24in. Hyd. Plain Cyl. Grinder, plunge feed.
CHURCHILL 10in. × 24in. Hyd. Plain Cyl. Grinder.

GUILLOTINES

PRATT 3ft. 6in. × 16 gauge U/Crank Power Guillotine.

LATHES

COLCHESTER 8½in. × 4ft. 6in. Gap Bed Lathe.
HERBERT 7 Comb. Turret. 2in. H/Spindle. Speeds 767 r.p.m.
HERBERT 9 Comb. Turret. 4½in. H/Sp. Speeds—400 r.p.m.
HERBERT Carbicut Lathe. Speeds—3,025 r.p.m.

MILLING MACHINES

MILWAUKEE 3H Horizontal Miller. Speeds—1,000. Table 63in. × 13½in.

NIBBLERS

W.F. 14 Gauge Nibbler. 59in. throat.

POLISHING SPINDLES

CANNING 3 and 5 h.p. Double Ended Polishing Spindles. H/Duty.

PRESSES

BRADLEY & TURTON No. 3 Flypress.
NORTON No. 4 Flypress.
NORTON 3BP Bar Type Flypress.
TAYLOR & CHALLEN 1274 Notching Press.
TAYLOR & CHALLEN B2 10 Ton O/F Power Press.
TAYLOR & CHALLEN 370 20 Ton O/F Power Press.
SWEENEY & BLOCKSIDGE 20 Ton O/F Power Press.
EDWARDS No. 21 40 Ton O/F Power Press.

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RAPIDOR 6in. Power Hacksaw.
NEW RAPIDOR 6in. Power Hacksaw.
SPEEDAX 9in. Power Hacksaw.
BARSON No. 1 High Speed Circular Saw. Cap. 1½in. rounds, 2in. tubes, 1½in. × ⅜in. flats, 1½in. × ¼in. angles.

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CHURCHILL-REDMAN 18in. Shaper. Univ. table.

All machines 400/3/50 electrics unless otherwise stated

THE MIDLAND MACHINE TOOL CO.

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Classified Advertisements (*PLANT FOR SALE, contd.*)

HELIOT MACHINE TOOLS LTD

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CENTEC 3R electronic controlled high speed kneeless type automatic production miller, fully automatic cycle including elevation to head, spindle speeds up to 3,000 R.P.M., table traverse 14in., 34in. × 11in. table. **Price £725.**

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WARD No. 7 capstan lathe, covered bed, 2in. bar capacity, with collet and bar feed, surfacing, sliding and screwcutting, maximum swing 16½ in. spindle speeds 37–750 R.P.M. (2 machines available.) **Price £1,250 each.**

DRUMMOND K. capstan lathe, chucking machine, spindle bored 2$\frac{1}{16}$in., power feeds to cross slide, saddle and turret, maximum swing 17in., maximum distance spindle to turret 30in., spindle speeds 60–1,000 R.P.M. **Price £375.**

WARNER & SWASEY No. 5 capstan lathe, chucking machine, spindle bored 2$\frac{11}{16}$in., power feeds to cross slide, saddle and turret, maximum swing 19½in., spindle speeds 26–658 R.P.M. **Price £650.**

TURRET LATHES

WARD No. 16 turret lathe, covered bed, 32in. chuck, spindle bored 8½in., screwcutting, power and rapid feeds to cross slide, saddle and turret, power rotating turret, spindle speeds 7–225 R.P.M., maximum distance spindle to turret, 99in. **Price £3,500.**

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HERBERT 7A Preoptive turret lathe, as above, but fitted with taper turning attachment and collet head. **Price £990.**

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HOLBROOK 6½in. centre lathe, straight vee bed, 30in. between centres, surfacing, sliding and screwcutting, spindle speeds 15–400 R.P.M. quick change gear box, taper turning attachment. **Price £325.**

DEAN, SMITH & GRACE 4BR 10in. centre lathe, straight bed, 42in. between centres, surfacing, sliding and screwcutting, spindle speeds 27–602 R.P.M., patent feed box, taper turning attachment. **Price £700.**

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BROWN & SHARPE No. 2 surface grinder, mechanical feed, 18in. × 6in. capacity. **Price £180.**

WICKMAN 14C double sided tool grinding and lapping machine, 14in. × 2in. × 1½in. double faced grinding wheels, 31in. × 19½in. recessed canting tables, coolant pump. **Price £250.**

JACKMAN No. 28, horizontal disc grinder, 51in. diameter grinding disc, with overhead trueing attachment. **Price £150.**

CHURCHILL OSB horizontal spindle surface grinder 30in. × 8in. capacity, variable hydraulic table feeds, 10in. diameter grinding wheel mounted on cross adjustable head. **Price £425.**

DRILLING MACHINES

ARCHDALE 5ft. radial drilling machine, low base, power elevating arm, No. 4 Morse taper, tapping reverse, spindle speeds 40–2,000 R.P.M., maximum spindle feed 12½in., maximum spindle to base 56in. **Price £875**

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NILES POND 6ft. Double Column Borer. Power traverse all ways. Motorised.
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KELLER Model B.L. Die Sinking Machine. Table 48in. × 26in. 16 spindle speeds, 4-3,600 r.p.m. Motorised.

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CHURCHILL Model D. Cylindrical Grinder. Cap. 30in. dia. × 56in.
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THE CAUSEWAY, EGHAM
SURREY
EGHAM 4166-7

SNOW Horizontal Spindle Surface Grinder, hydraulic. Motor drive 400/440 volts, 3 phase, 50 cycles. Table working surface 24in. by 8in.

DISKUS Vertical Spindle Surface Grinder, hydraulic. Motor drive 380 volts, 3 phase, 50 cycles. Table working surface 32in. by 10in. Segmental grinding wheel 14in. diameter.

CHURCHILL Horizontal Spindle Surface Grinder. Motor drive 400 volts, 3 phase, 50 cycles. Table working surface 36in. by 12in

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GREENLEE 1in. × 6 spindle.
PETERMAN No. 0.
BORERS (Horizontal)
KEARNS No. 2.
BROACHING
AMERICAN model H2, stroke 30in.
CAPSTANS
MURAD ⅜in.
HERBERT 4, Ball Chuck.
CUTTING-OFF MACHINES
TAYLOR 10in.
DRILLS
NATCO 24 spindle No. 1 M.T.
CORONA Type 15CX 2 spindle.
HERBERT 2 spindle. Type V.H.
DENBIGH 24in. B.G.
HERBERT " C " Power Feed.
CORONA IAX, No. 1 Morse Taper.
LELAND GIFFORD 2-sp., No. 2 M.T.
HERBERT Type B. Single Spindle, ¼in.
CORONA 6MX Cluster Type.
HERBERT Type H, ½in. cap.
CORONA 9FX ¼ Capacity.
BOLEY Multi Spindle.
ENGRAVERS
LIENHARD 3-dimensional. (New.)
HUPFIELD Router.
T.T. & H. Type C, C.B. and M.A.
T.T. & H. Multi Etcher.
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JONES No. 13 Bandsaw.
RAPIDOR 6in. Hacksaw.
RAPIDOR Filing and Sawing.
FOLDERS
Sheet Edging, 30in. × 22g.
GEAR CUTTERS
SAFAG Pinion.
MAXICUT 7in. × 2in. × 6 D.P.
PETERMAN No. 1 and 2.
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NOVA A, with facing head.
CHURCHILL HBY.
BRYANT 16/38 and 5.
GRINDERS (Surface)
CHURCHILL OSB, 8in. × 30in.
LUMSDEN Vert. 210 XXM.
ABRASIVE No. 34 Vertical Spindle.
GRINDERS (Cylindrical)
PRECIMAX MPB, 10in. × 15in.
CHURCHILL 6 × 36in. B.Y.
CHURCHILL PBH 12 × 36in. Univ.
GRINDERS (Miscellaneous)
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BROWN & SHARPE No. 10 and 13 T. & C.
J. & S. "Perfect Point" 0·010in.-½in. Drill.
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NEWALL 420 Univ. Threads.
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HUNT No. 0, 2 and 3 Drill.
CHURCHILL Valve.
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EDGWICK 4in.
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ROSCHER EICHLER. Table 39in. × 12in
ST. ANDREA Model UFO3, Table 57 × 14.
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ASQUITH Duplex Keyseater HKO.
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REED PRENTICE No. 5, 68in. × 16in. table.
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MECO 3 ton capacity.
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Member of B.A.M.T.M.

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ZOCCA COMO
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Model R.P.A. 3000
carrying 1 horizontal and 2 vertical spindles

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Width........................ 24in.
Length.................. 10ft. 6in.
Traverse longitudinal 7ft. 0in.

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PACERA MF.5 1in. Pillar Drill.
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Range of ½in. Bench and Pedestal Drills by, **PROGRESS, PACERA, KERRY, UNION, FOBCO,** etc.

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WICKSTEED 10in. Hacksaw.
VELOX 6in. Hacksaw.
VELOX 10in. Hacksaw.
QUALTERS & SMITH 6in. Sawmaster Hacksaw.
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INVICTA 4M 18in. Stroke Shaper.
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MILLING MACHINES

VICTORIA V.2R Rapidmill Vertical Mill.
VARNAMO FU.2 Universal Mill.
VICTORIA Juniormil Plain Horizontal Mill.
VICTORIA Juniormill Horiz. and Vert. Mill.
CENTEC 2B Horizontal Mill.
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RICHMOND Turret Milling Machine with New Power Down Feed Head.
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Published by The Machinery Publishing Co., Ltd., at their Office, Clifton House, 83-117, Euston Rd., London, N.W.1. Telephone Euston 8441.
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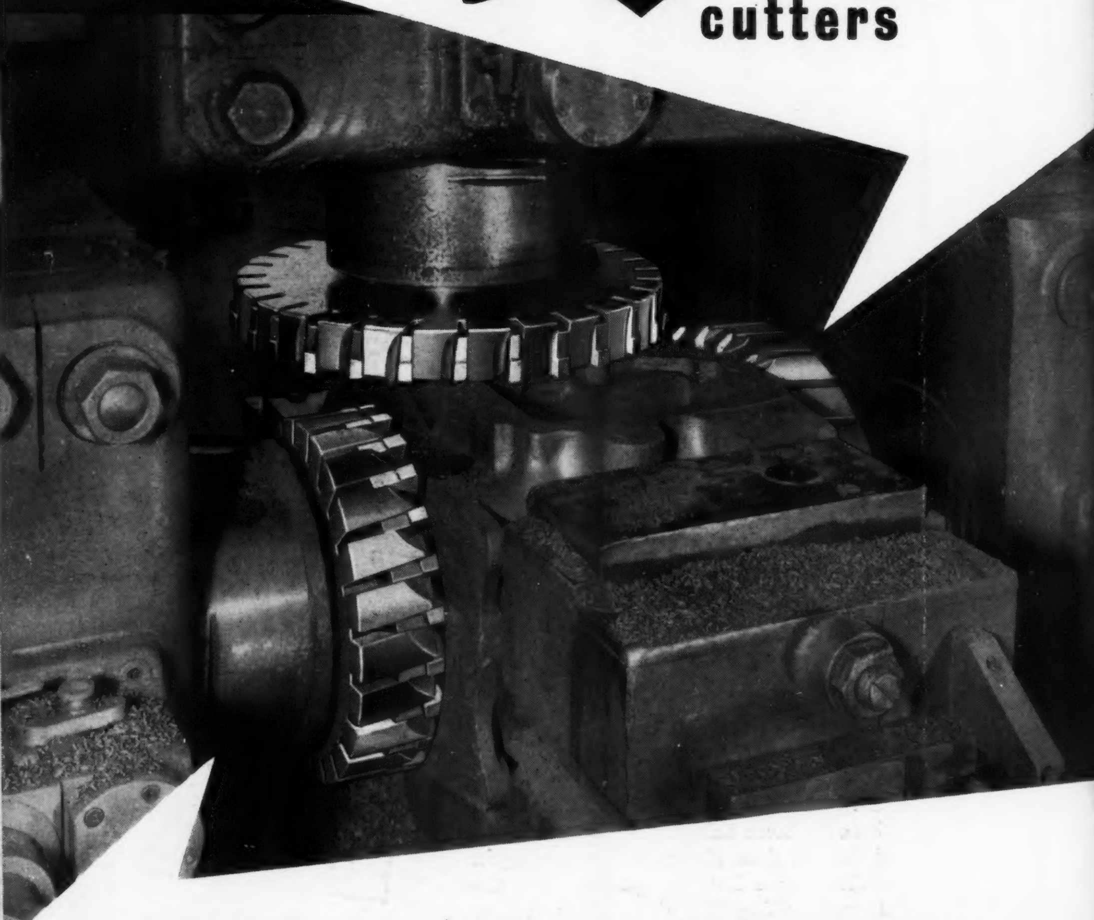

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